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(12) **United States Patent**
Ota et al.

(10) **Patent No.: US 12,098,049 B2**
(45) **Date of Patent: Sep. 24, 2024**

(54) **MEDIUM PROCESSING APPARATUS AND IMAGE FORMING SYSTEM INCORPORATING SAME**

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(72) Inventors: **Kazuki Ota**, Kanagawa (JP); **Yohei Yamazaki**, Kanagawa (JP); **Yuji Miyachi**, Kanagawa (JP); **Yusuke Hirono**, Kanagawa (JP); **Yuta Yanai**, Kanagawa (JP); **Yuji Susaki**, Kanagawa (JP); **Masanobu Kimata**, Kanagawa (JP)

(73) Assignee: **Ricoh Company, Ltd.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Apr. 19, 2022 (JP) 2022-068874

(51) **Int. Cl.**
B65H 37/04 (2006.01)
B65H 39/10 (2006.01)

(52) **U.S. Cl.**
CPC ***B65H 37/04*** (2013.01); ***B65H 39/10*** (2013.01); *B65H 2301/1635* (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC B54H 2408/1223; B65H 2301/1635; B65H 2408/1222; B65H 2801/27; B65H 39/10;
(Continued)

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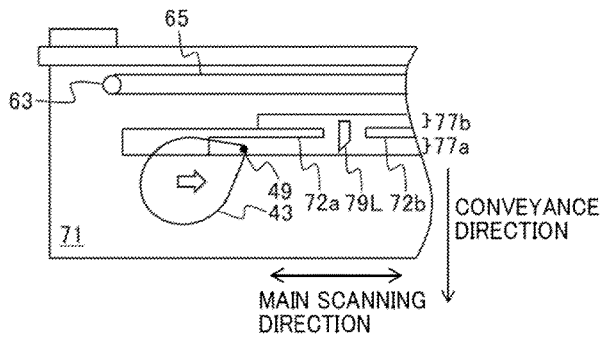
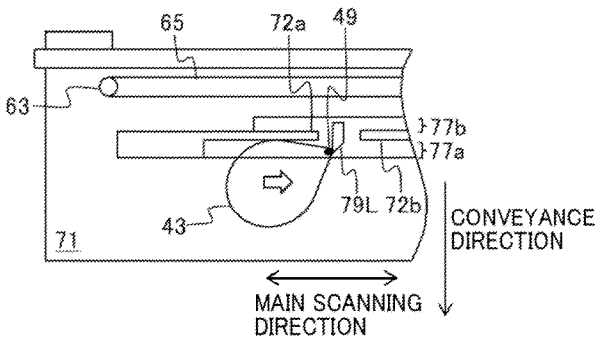
Primary Examiner — Jennifer Bahls
(74) *Attorney, Agent, or Firm* — IPUSA, PLLC

(57) **ABSTRACT**

A medium processing apparatus includes a conveyor, a tray, a binder, a mover, and a switcher. The switcher includes a first passage, a second passage, and a movable wall. The movable wall guides a guided portion of the binder to the second passage when the guided portion moving along the first passage from an end side to a center side contacts the movable wall; causes the guided portion to pass when the guided portion moving along the second passage from the end side to the center side contacts the movable wall; guides the guided portion to the first passage when the guided portion moving along the second passage from the center side to the end side contacts the movable wall; and causes the guided portion to pass when the guided portion moving along the first passage from the center side to the end side contacts the movable wall.

9 Claims, 20 Drawing Sheets





(52) **U.S. Cl.**
CPC *B65H 2301/51611* (2013.01); *B65H 2403/40* (2013.01); *B65H 2408/1223* (2013.01); *B65H 2801/27* (2013.01)

(58) **Field of Classification Search**
CPC B65H 37/05; B65H 2403/40; B65H 2301/51611
See application file for complete search history.

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FIG. 1

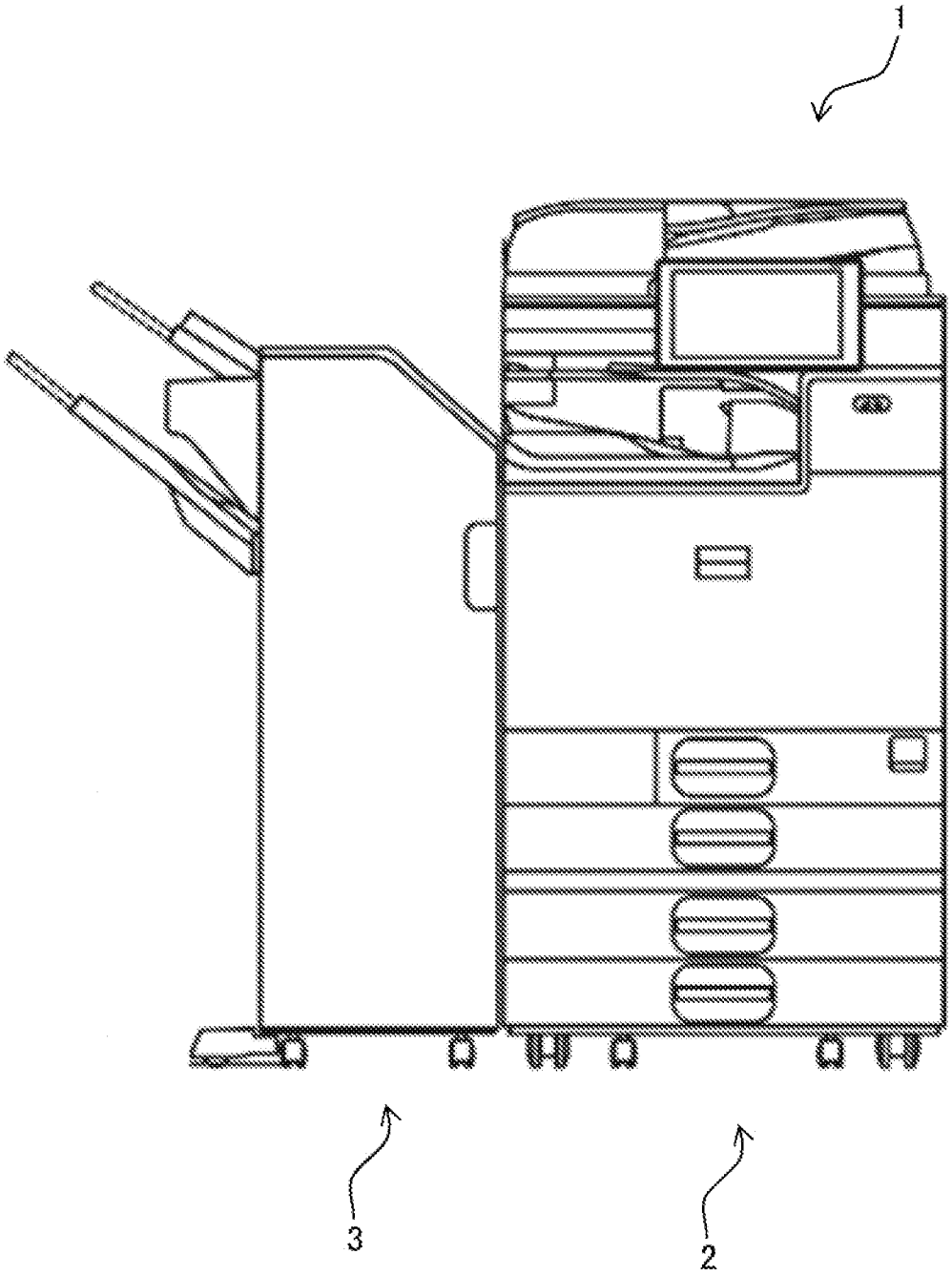


FIG. 2

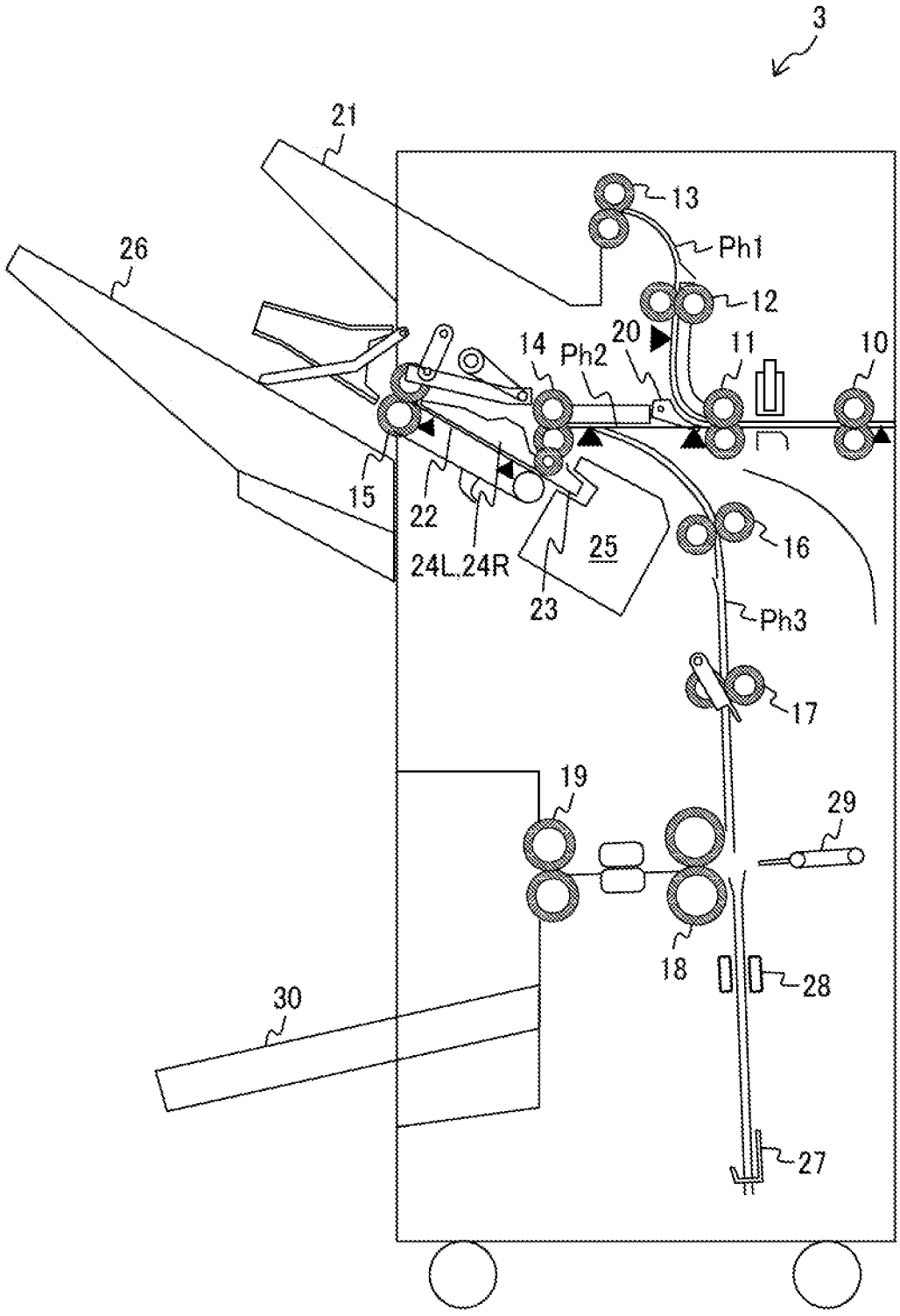

3
21
26
13
Ph1
12
20
14
Ph2
11
10
15
22
24L.24R
25
23
16
Ph3
17
19
29
18
28
30
27

FIG. 3

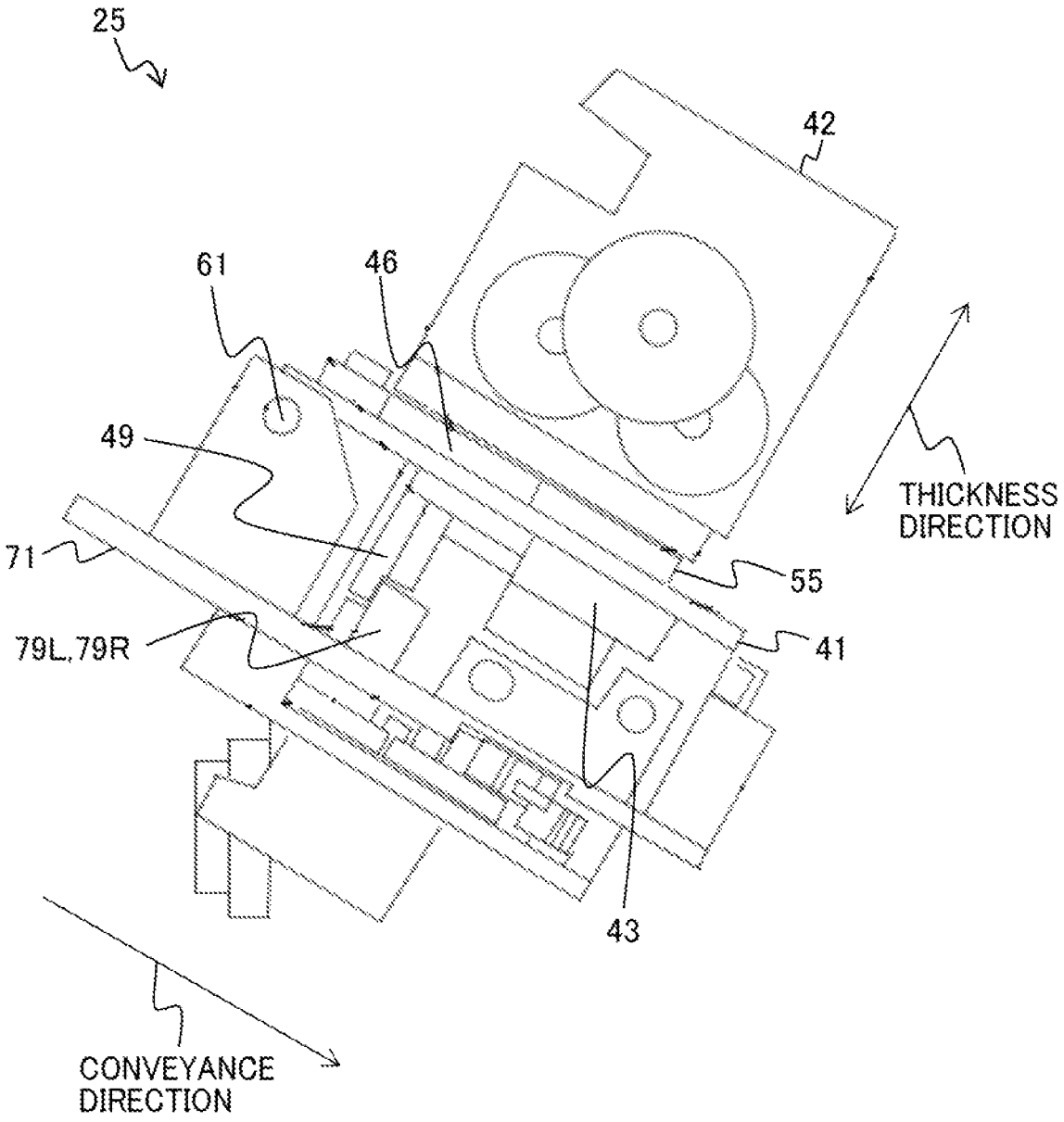

25
42
61
46
49
71
79L,79R
55
41
43
THICKNESS DIRECTION
CONVEYANCE DIRECTION

FIG. 4

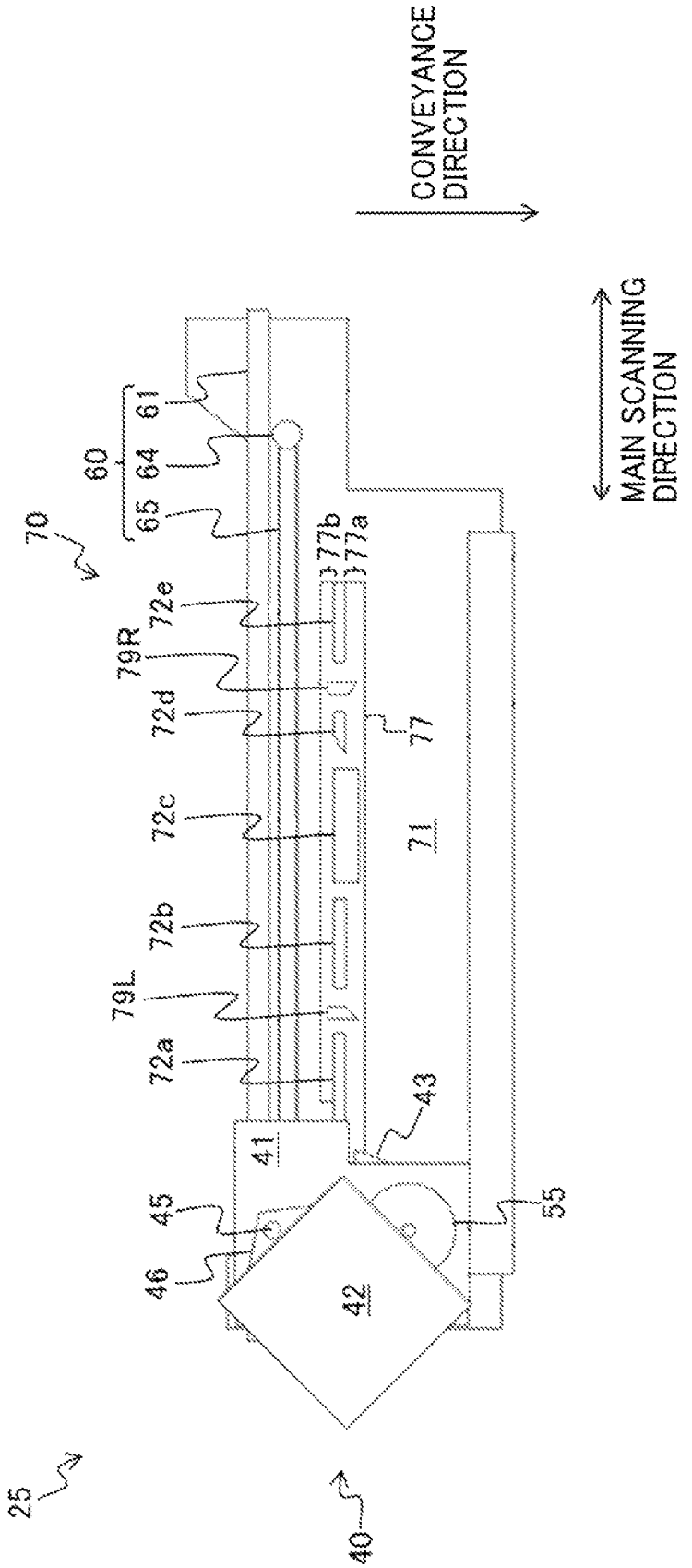

CONVEYANCE DIRECTION
MAIN SCANNING DIRECTION
70
60
61
64
65
77b
77a
72e
79R
72d
77
72c
71
72b
79L
72a
43
41
45
46
42
55
25
40

FIG. 5B

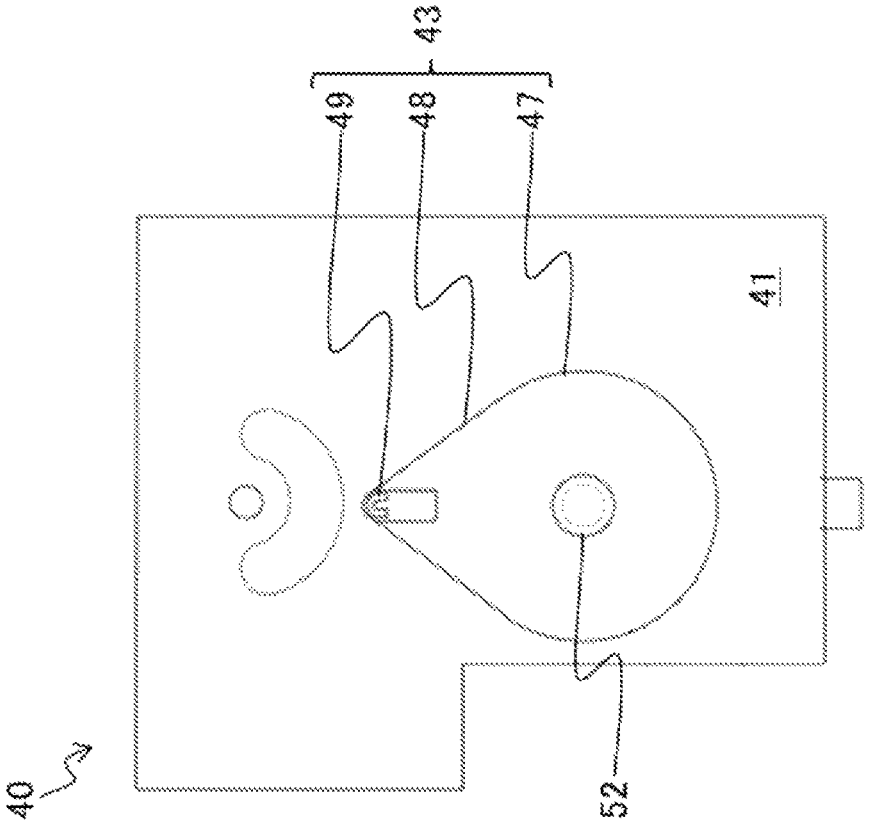


FIG. 5A

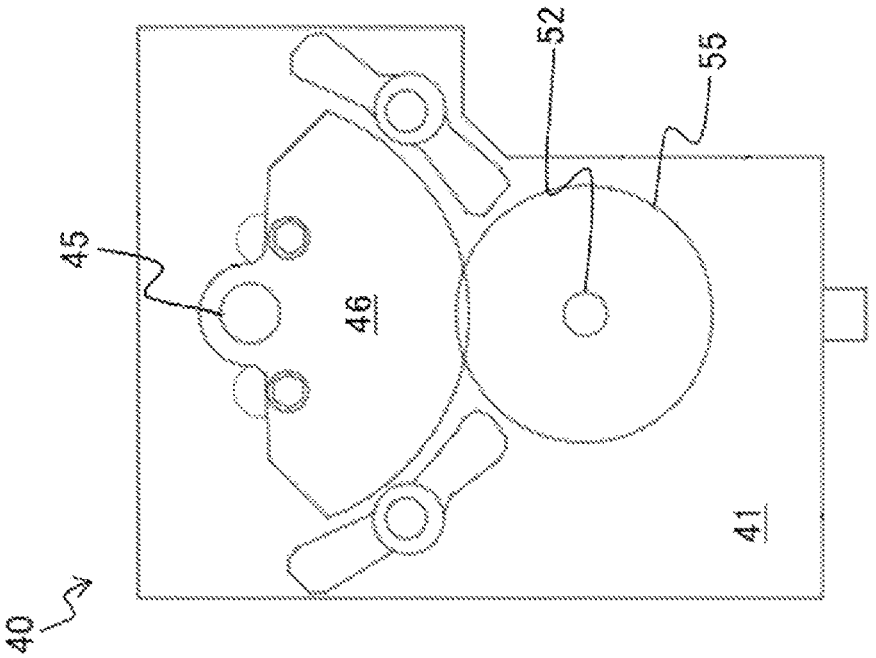


FIG. 6B

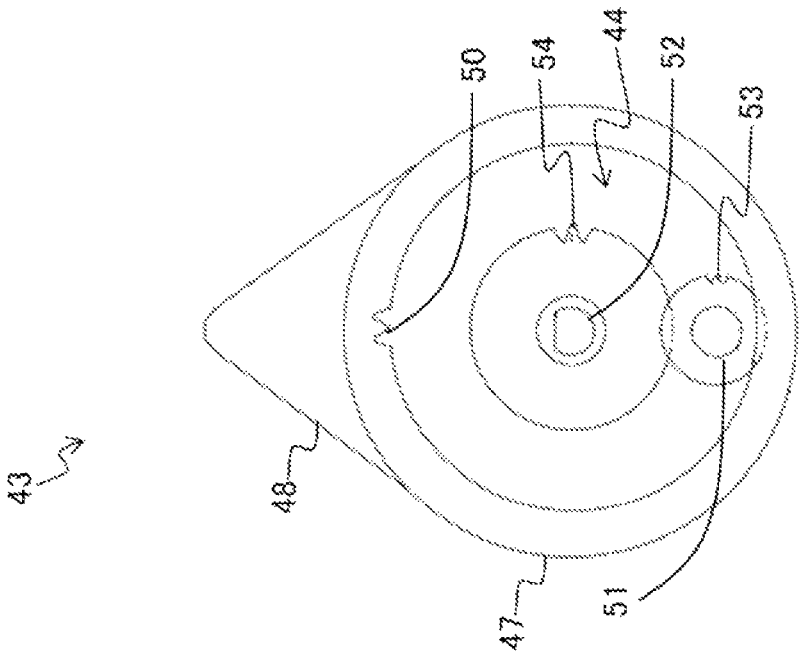


FIG. 6A

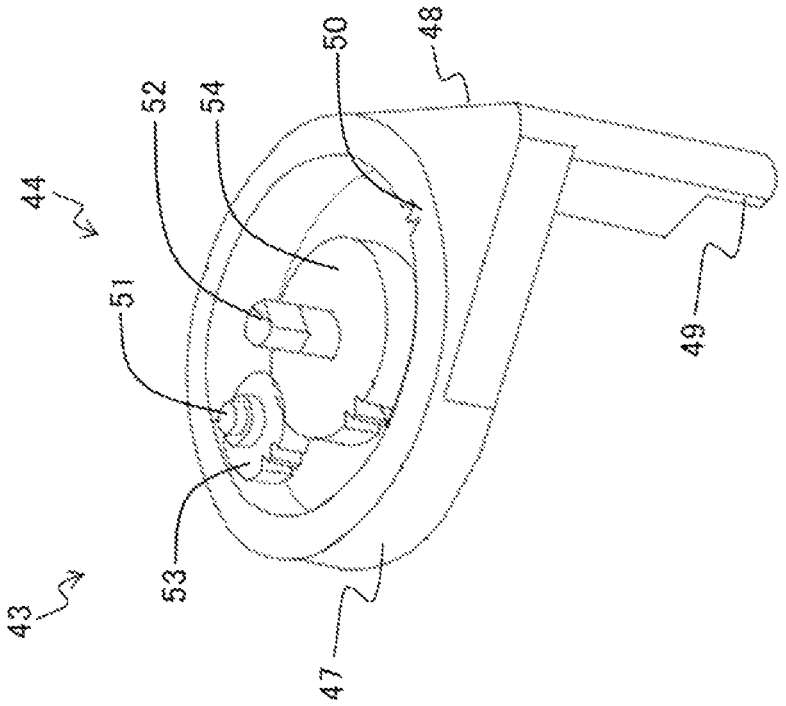


FIG. 7A

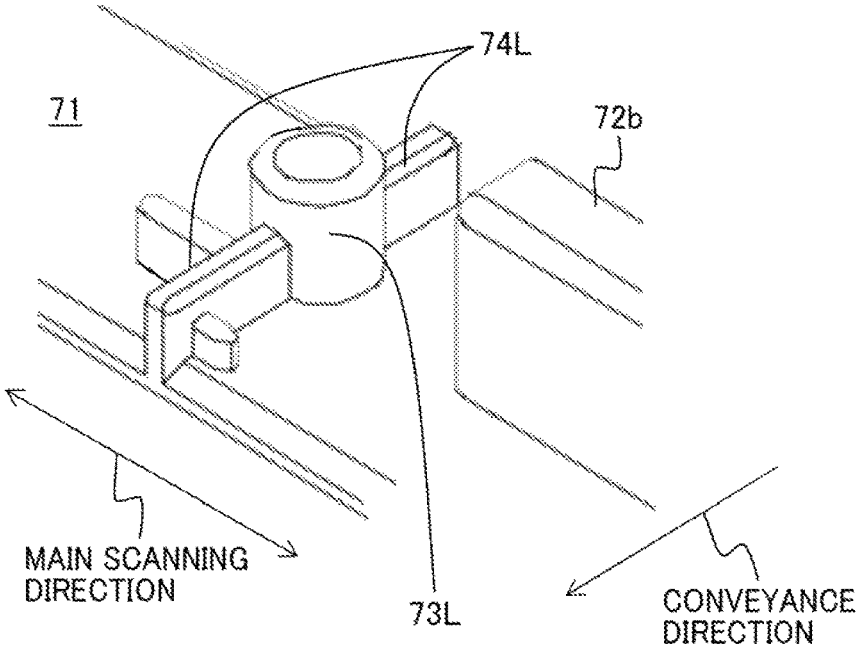
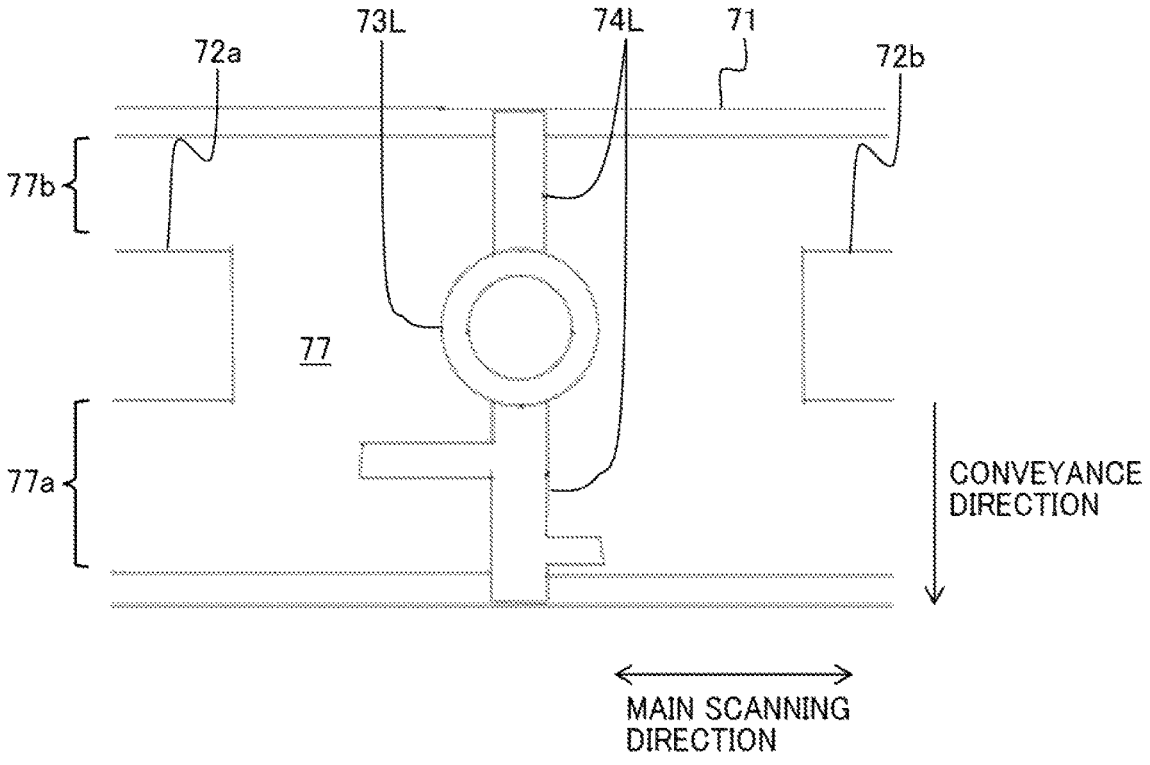

74L
71
72b
MAIN SCANNING
DIRECTION
73L
CONVEYANCE
DIRECTION

FIG. 7B


73L
74L
71
72a
72b
77b
77
77a
CONVEYANCE
DIRECTION
MAIN SCANNING
DIRECTION

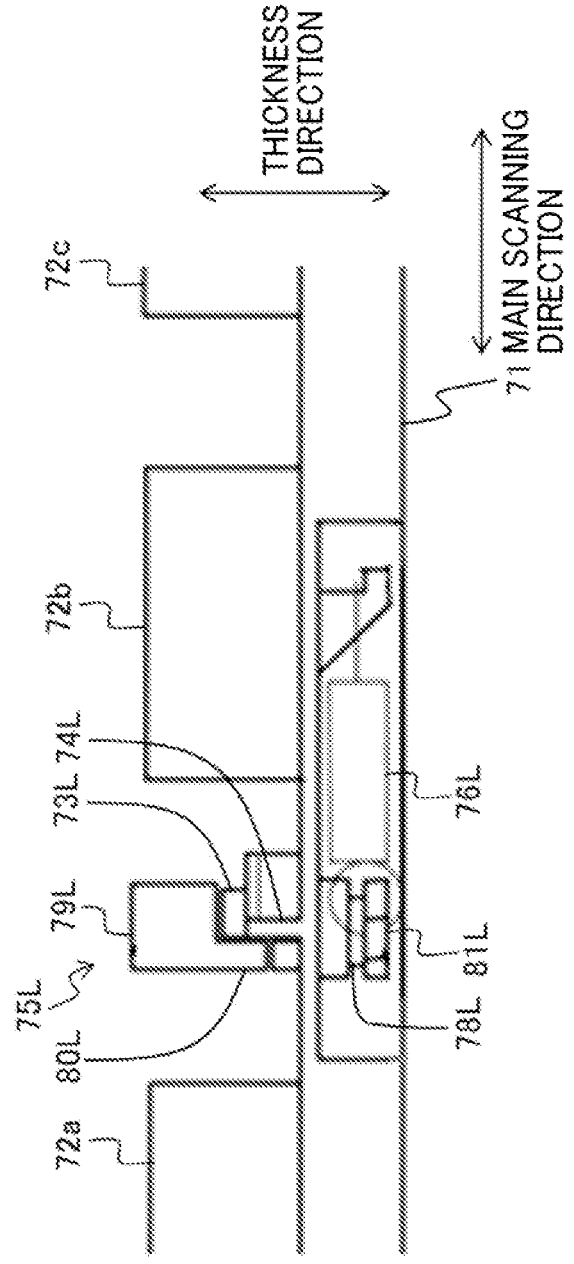

THICKNESS DIRECTION
MAIN SCANNING DIRECTION
72c
72b
72a
71
73L
74L
75L
76L
78L
79L
80L
81L

FIG. 8A

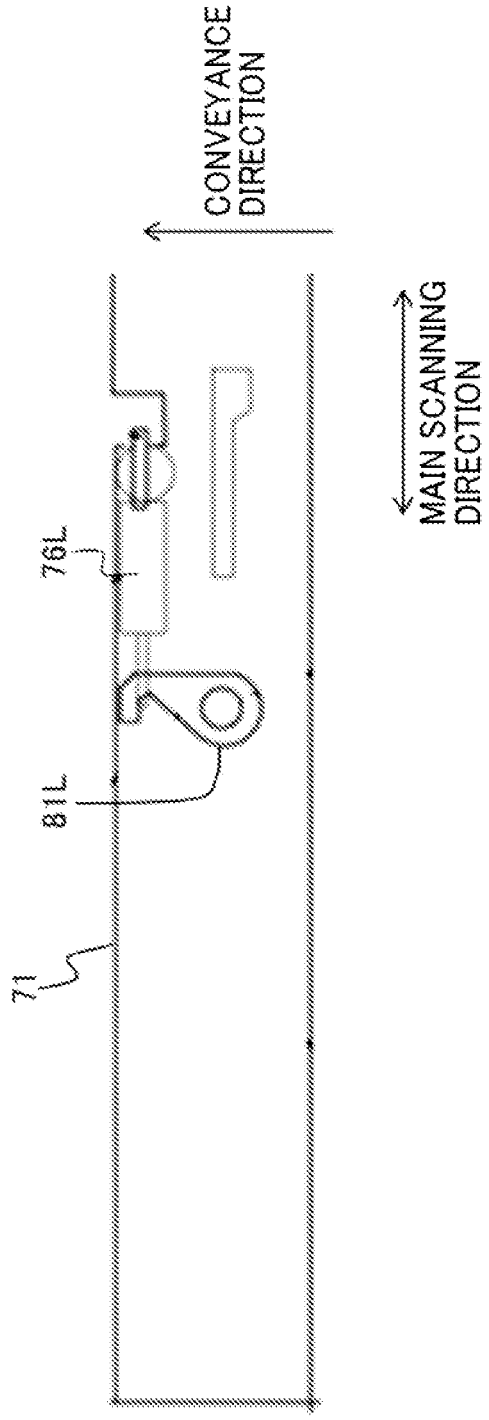

CONVEYANCE DIRECTION
MAIN SCANNING DIRECTION
71
76L
81L

FIG. 8B

FIG. 9

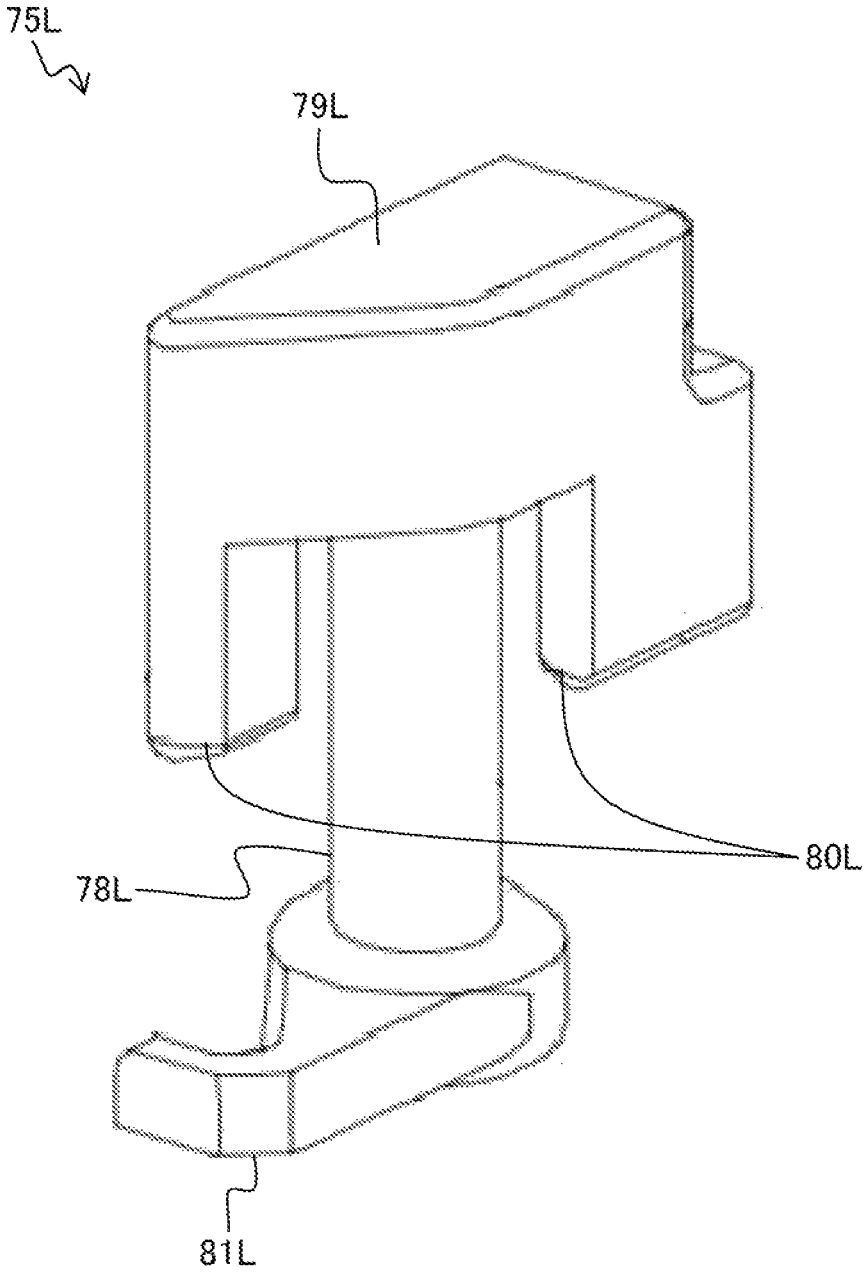


FIG. 10A

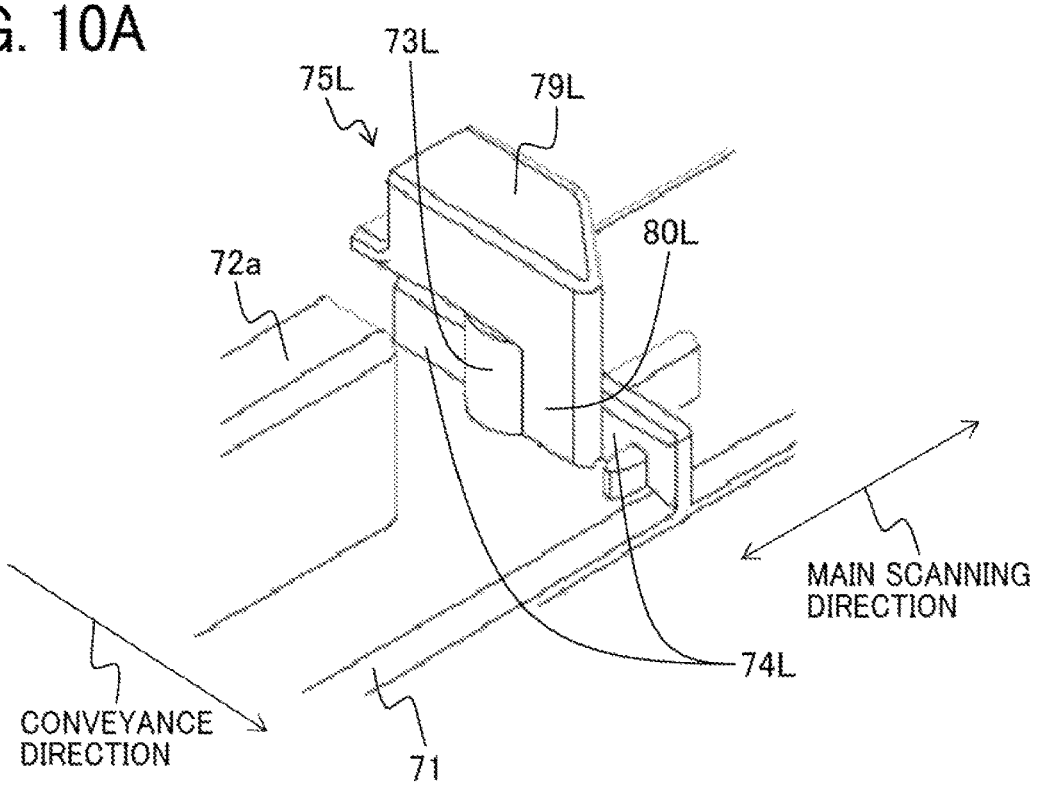


FIG. 10B

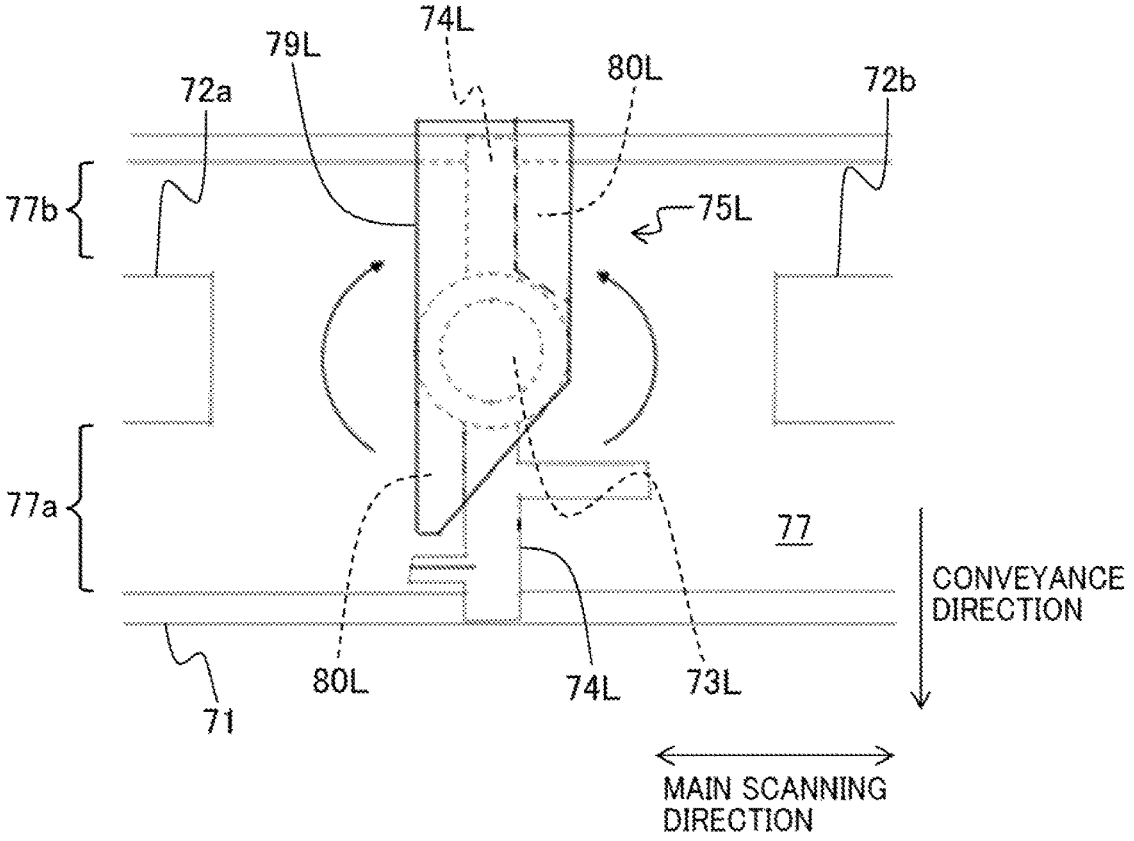


FIG. 11

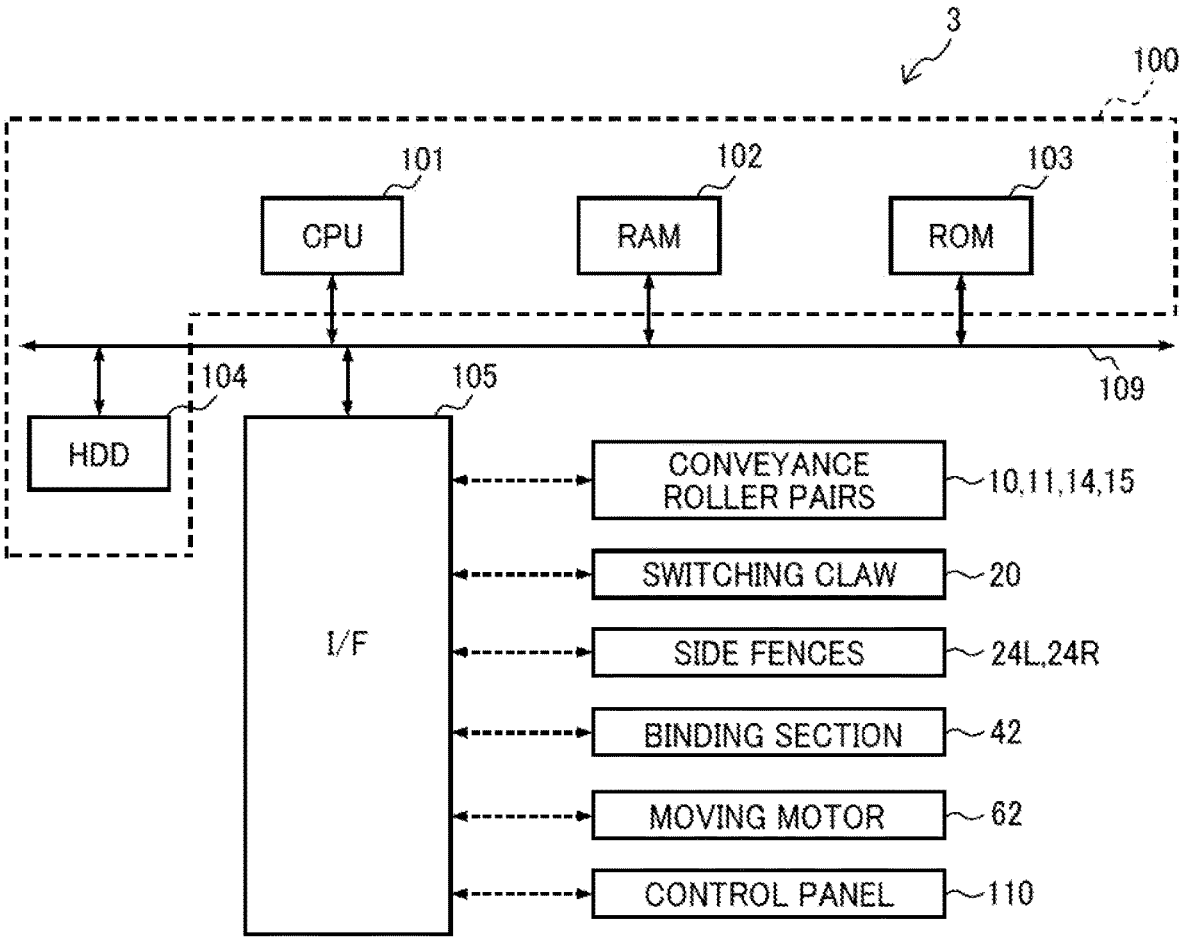

3
100
101
CPU
102
RAM
103
ROM
104
HDD
105
I/F
109
CONVEYANCE ROLLER PAIRS
10,11,14,15
SWITCHING CLAW
20
SIDE FENCES
24L,24R
BINDING SECTION
42
MOVING MOTOR
62
CONTROL PANEL
110

FIG. 12A

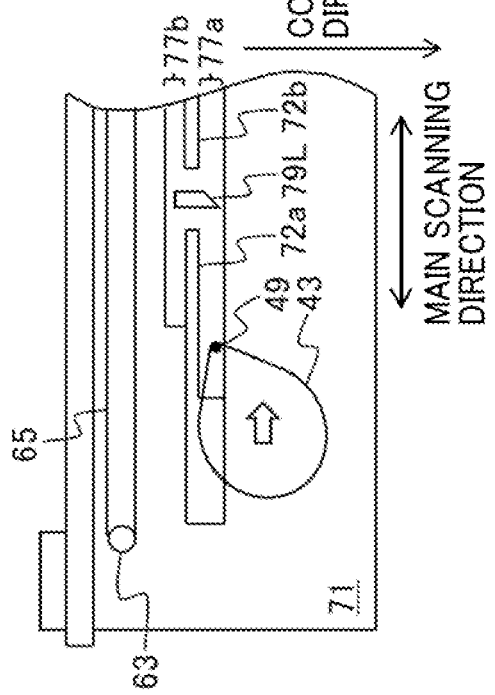


FIG. 12B

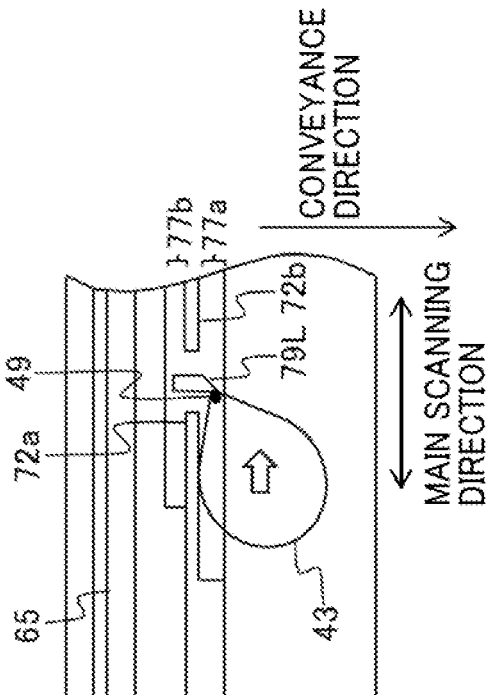


FIG. 12C

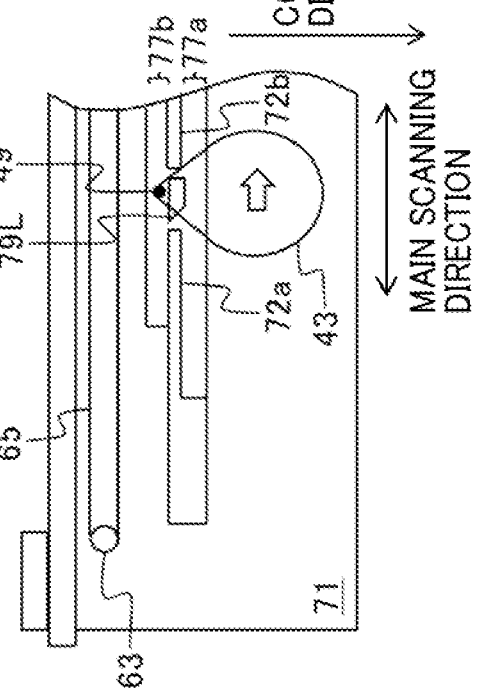


FIG. 12D

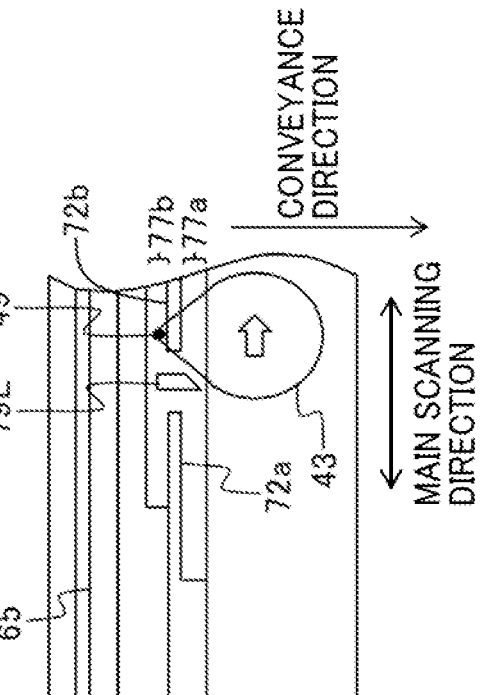


FIG. 13A

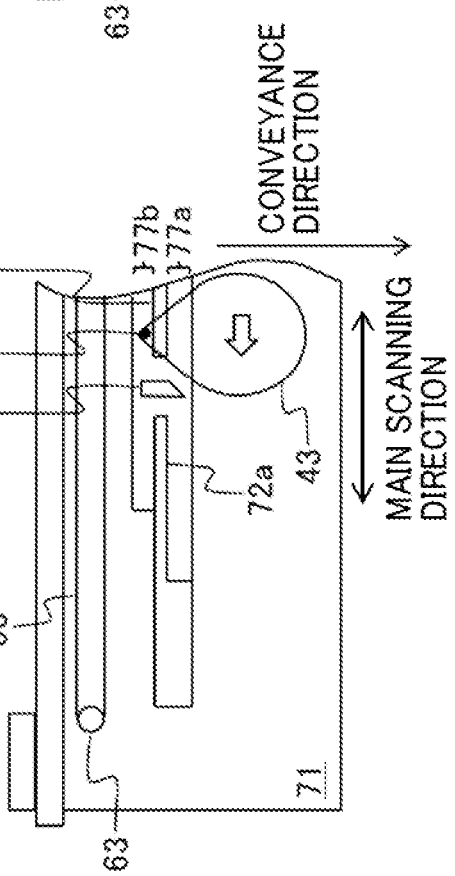


FIG. 13B

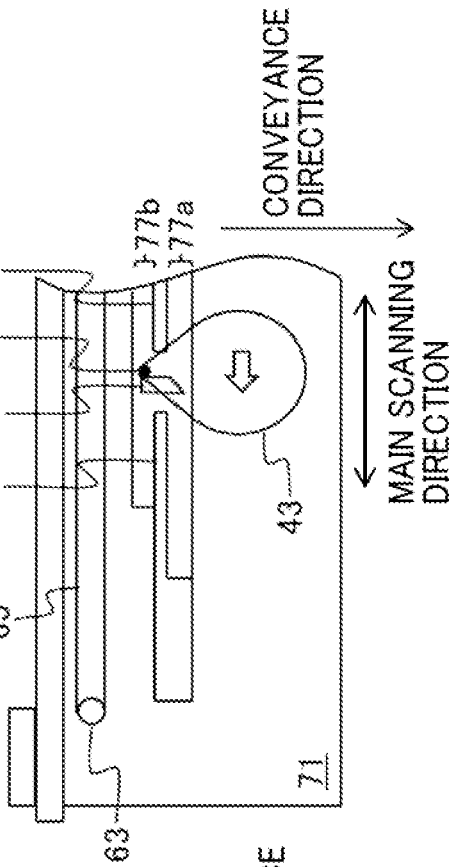


FIG. 13C

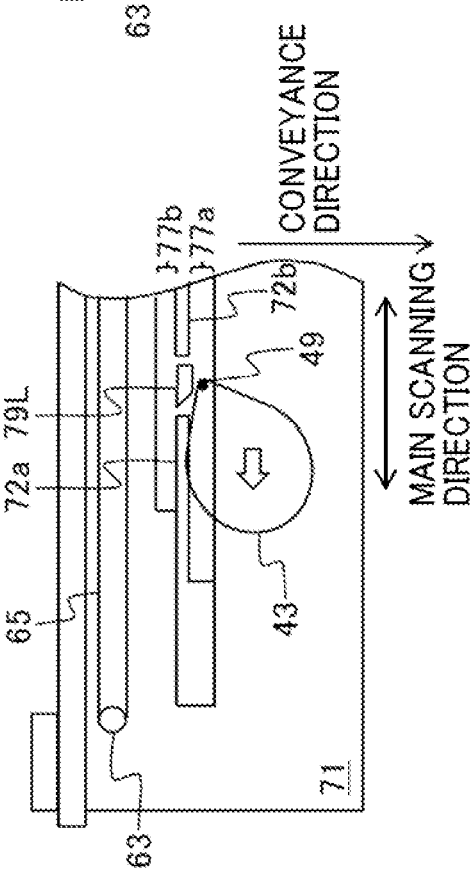


FIG. 13D

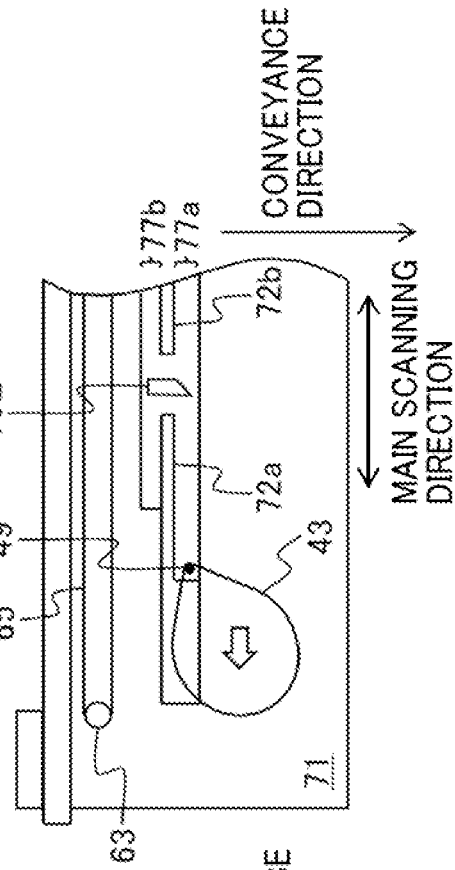


FIG. 14A

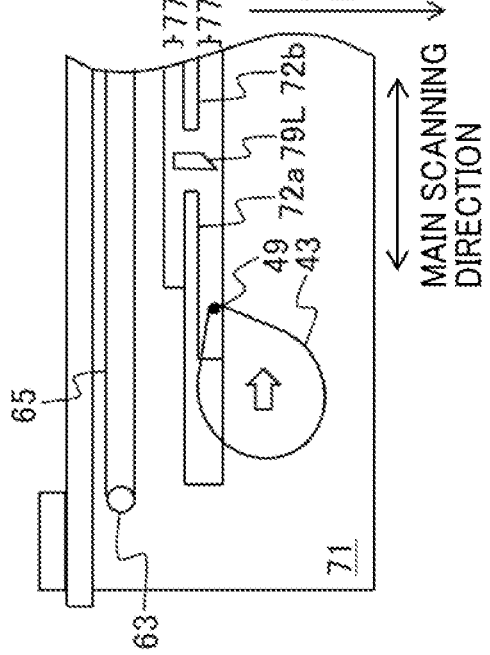


FIG. 14B

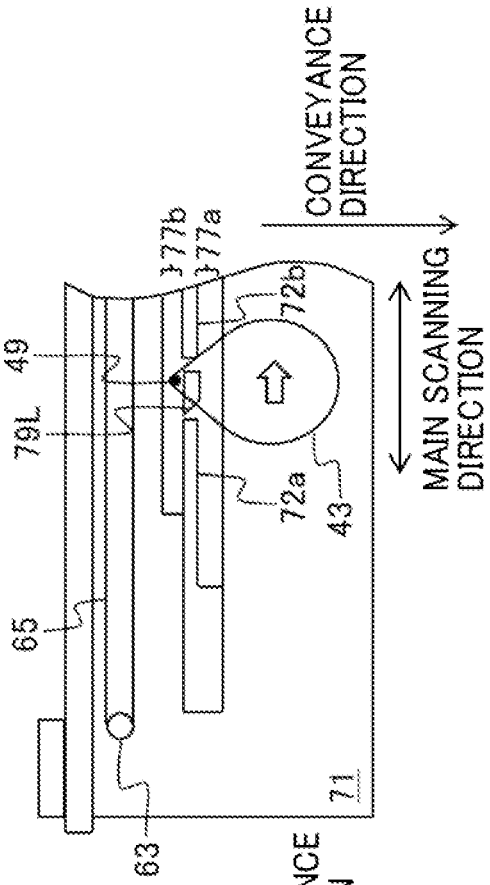


FIG. 14C

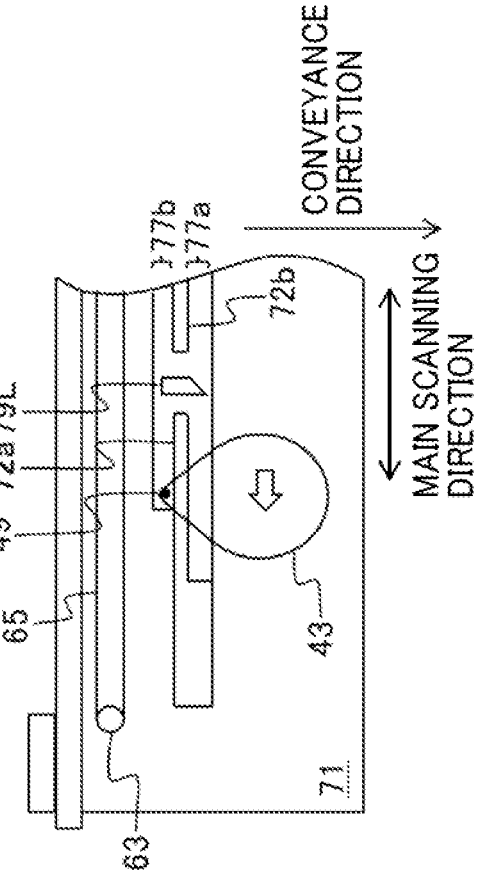


FIG. 15A

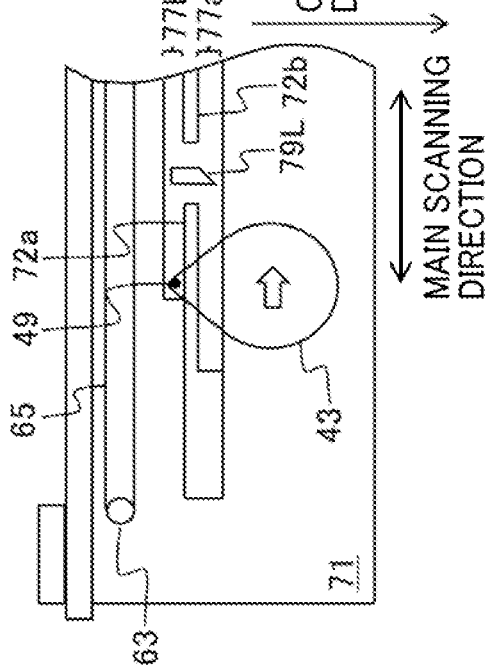


FIG. 15B

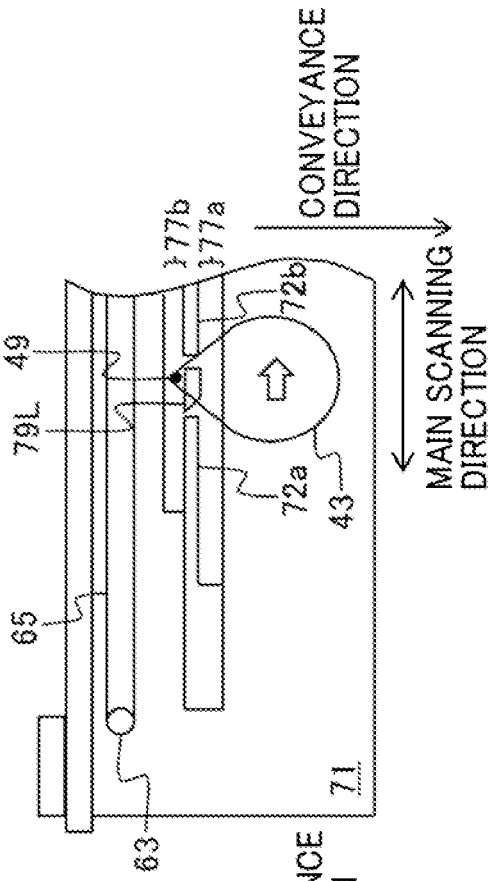


FIG. 15C

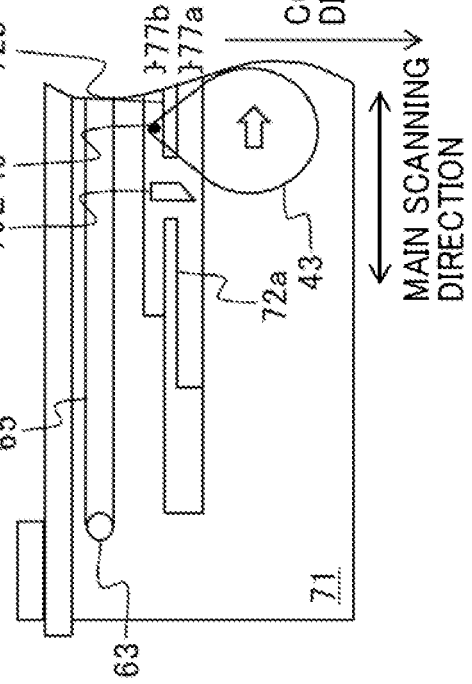


FIG. 16A

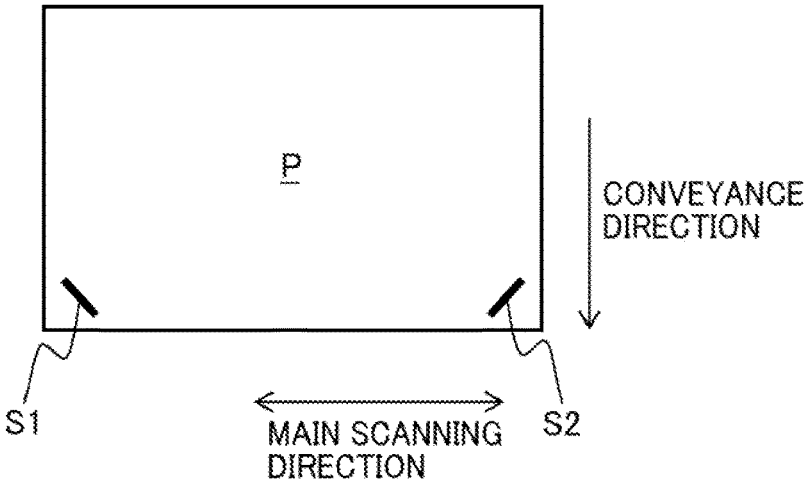


FIG. 16B

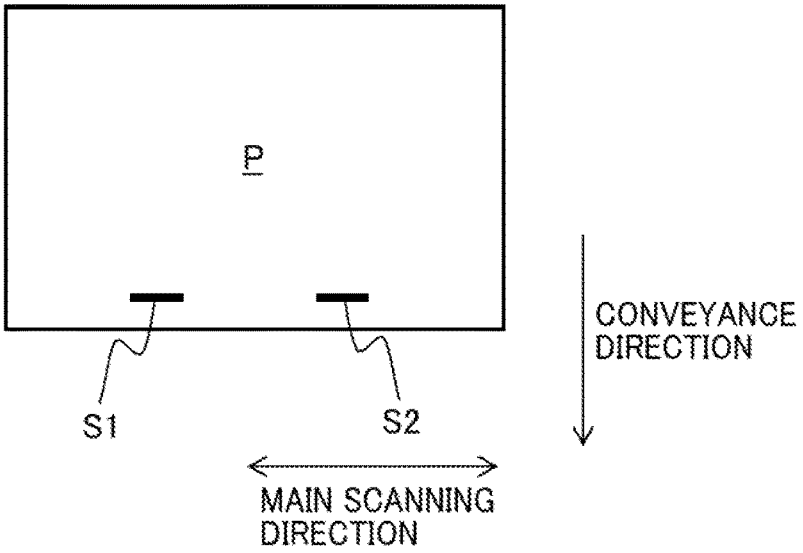


FIG. 16C

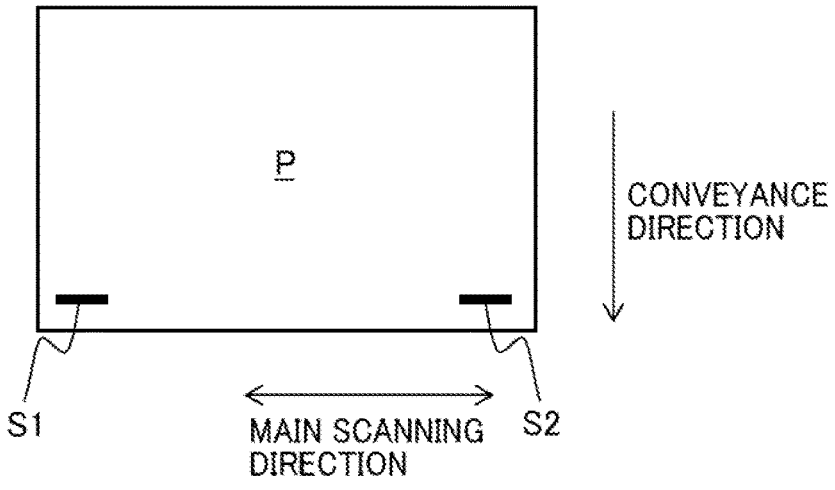


FIG. 17A

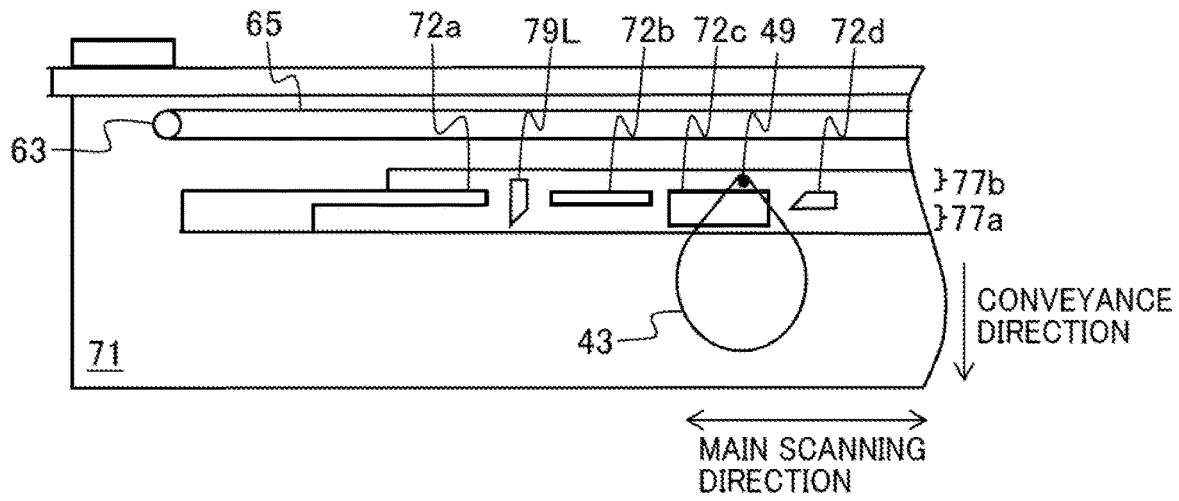


FIG. 17B

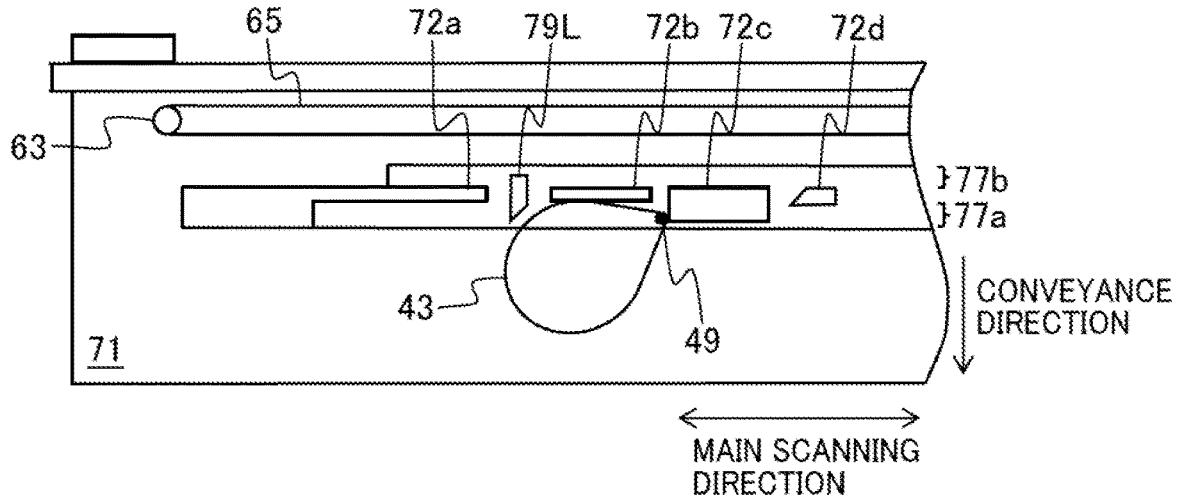
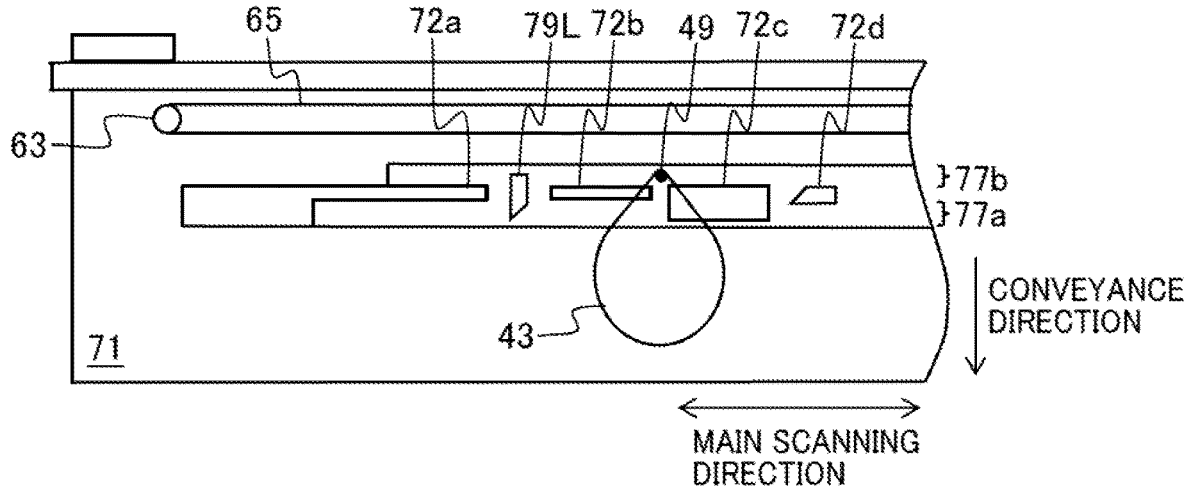


FIG. 17C



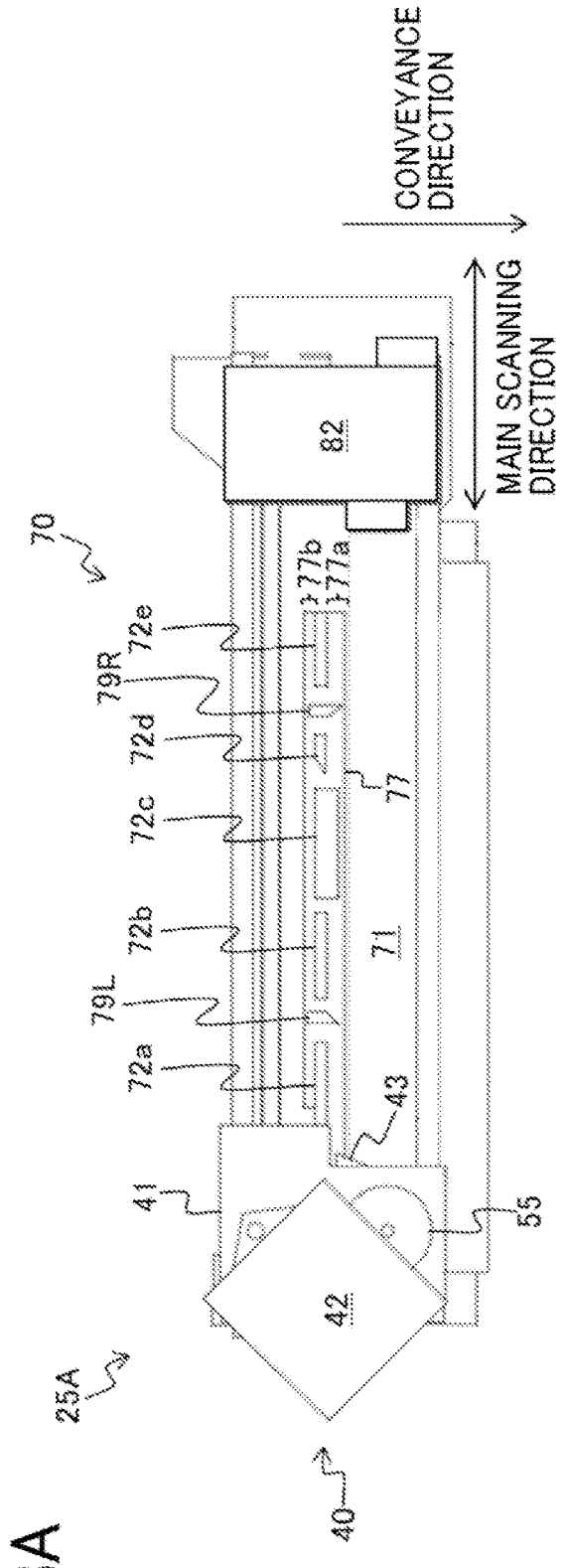


FIG. 18A

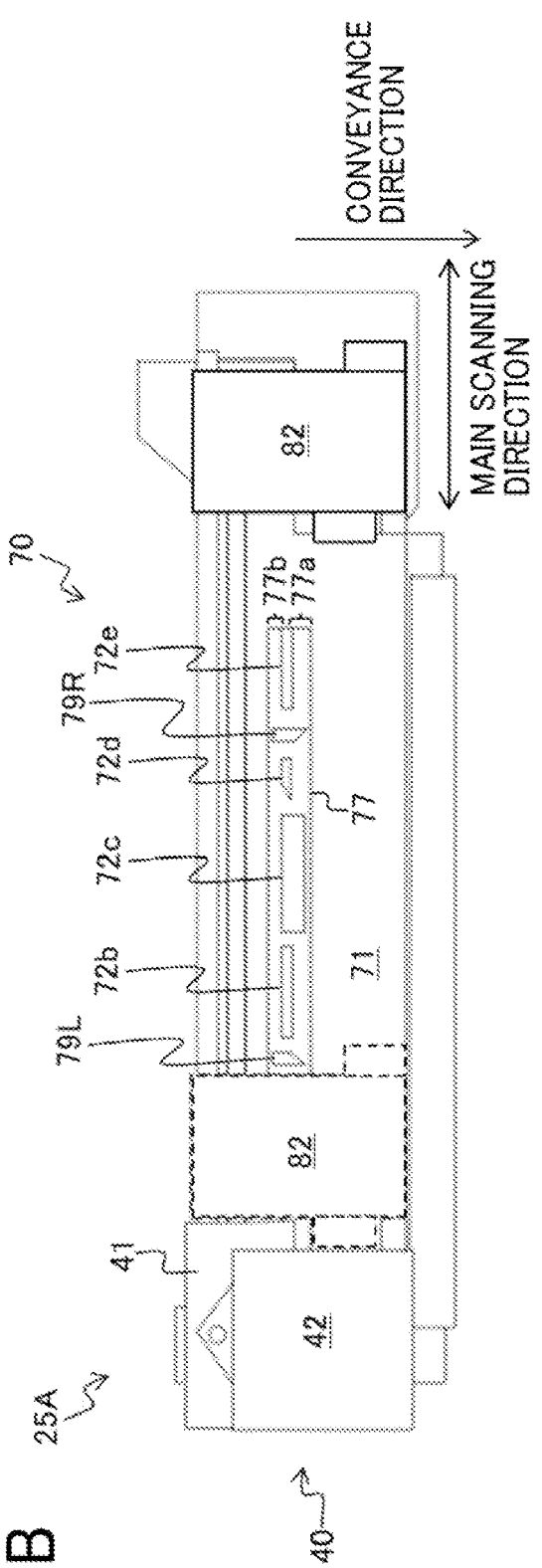


FIG. 18B

FIG. 19A

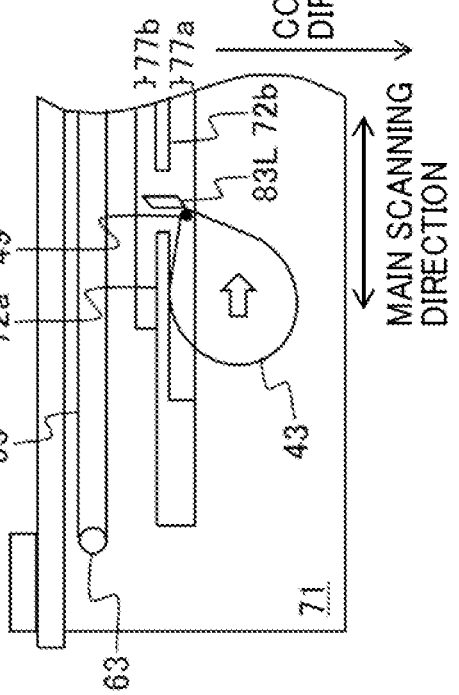


FIG. 19B

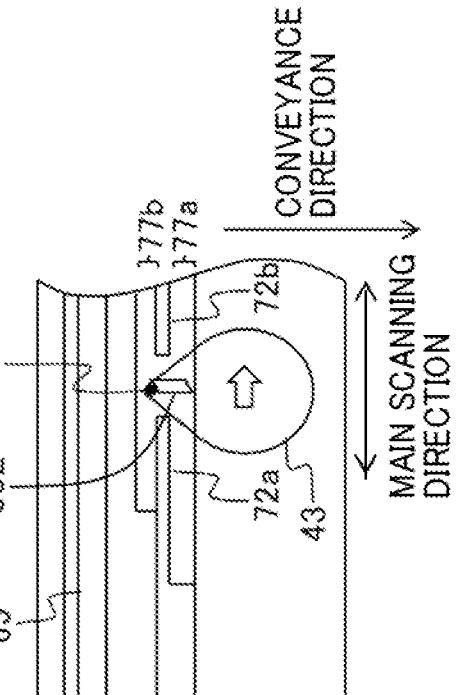


FIG. 19C

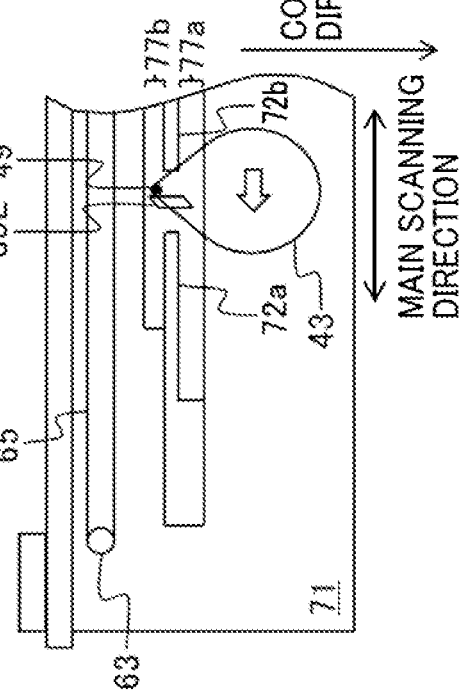


FIG. 19D

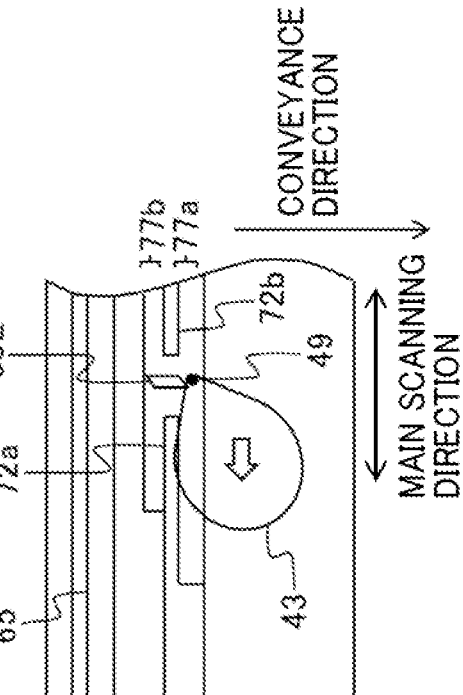


FIG. 20A

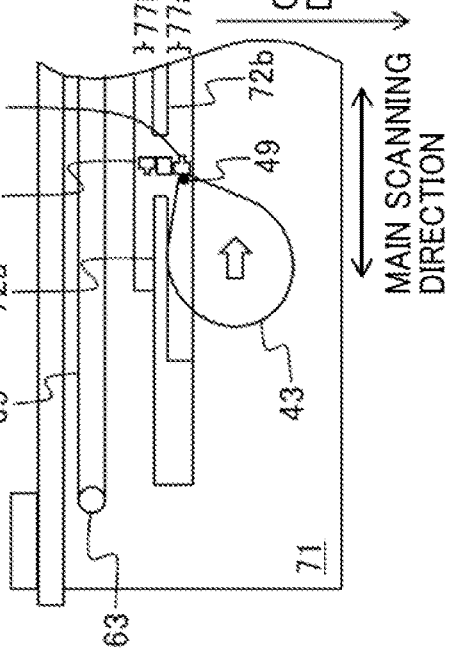


FIG. 20B

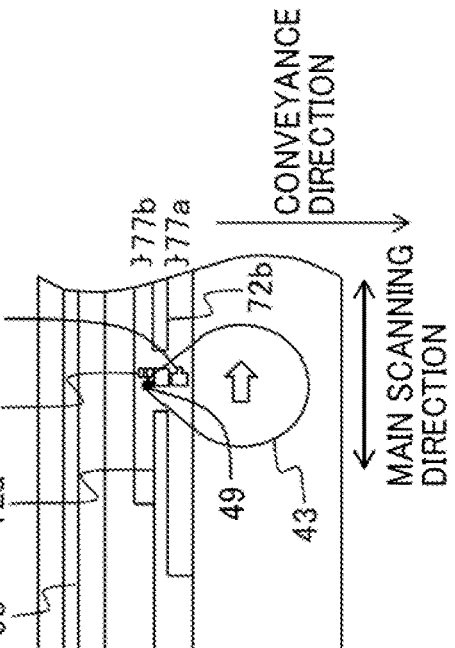


FIG. 20C

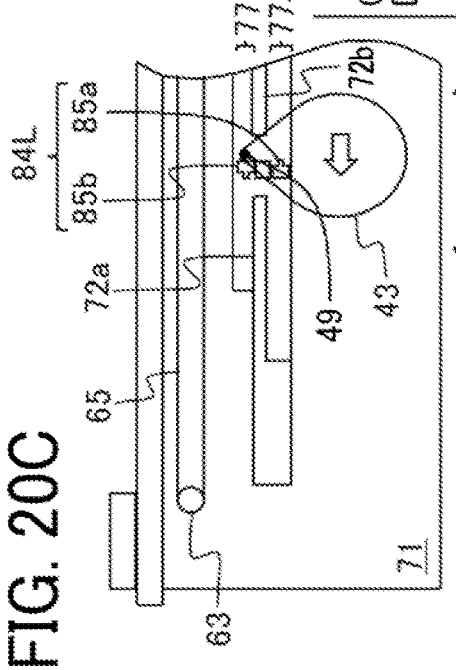
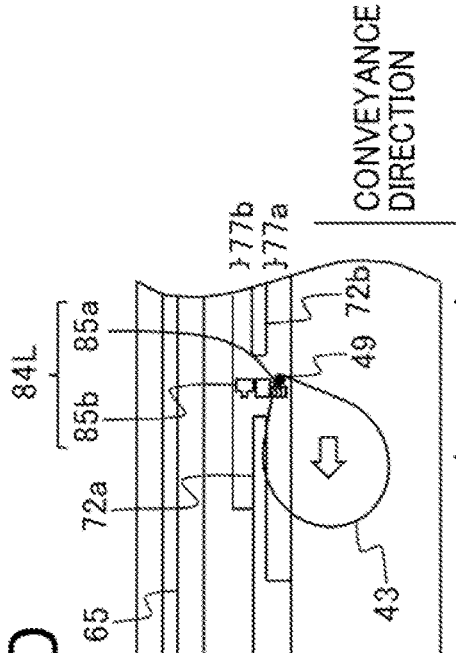


FIG. 20D



MEDIUM PROCESSING APPARATUS AND IMAGE FORMING SYSTEM INCORPORATING SAME

CROSS-REFERENCE TO RELATED APPLICATION

This patent application is based on and claims priority pursuant to 35 U.S.C. § 119(a) to Japanese Patent Application No. 2022-068874, filed on Apr. 19, 2022, in the Japan Patent Office, the entire disclosure of each of which is hereby incorporated by reference herein.

BACKGROUND

Technical Field

Embodiments of the present disclosure relate to a medium processing apparatus and an image forming system incorporating the medium processing apparatus.

Related Art

Medium processing apparatuses are known in the related art that bind, into a bundle, sheet-like media on which images are formed by image forming apparatuses. Since sheets of paper are widely known as an example of sheet-shaped media, a "sheet bundle" that is a stack of sheets of paper is used as an example of a bundle of sheet-shaped media in the following description. Such a medium processing apparatus includes, for example, a staple binder or a crimp binder (hereinafter, collectively referred to as a "binder"). The staple binder binds a sheet bundle using a staple. The crimp binder binds a sheet bundle by pressing and deforming the sheet bundle.

Some medium processing apparatuses configured as described above have a mechanism that changes the orientation of a binder between an oblique binding orientation in which media are bound obliquely with respect to the width direction (main scanning direction) of the media and a parallel binding orientation in which the media are bound in parallel with the width direction of the media.

SUMMARY

According to an embodiment of the present disclosure, a medium processing apparatus includes a conveyor, a tray, a binder, a mover, and a switcher. The conveyor conveys a medium in a conveyance direction. The tray supports a plurality of media conveyed by the conveyor. The binder binds the plurality of media supported on the tray. The mover moves the binder in a main scanning direction orthogonal to the conveyance direction along a surface of the plurality of media supported on the tray. The switcher guides a guided portion of the binder to switch between an oblique binding posture in which a longitudinal direction of a binding region bound by the binder is inclined with respect to the main scanning direction and a parallel binding posture in which the longitudinal direction of the binding region is oriented in the main scanning direction. The switcher includes a first passage, a second passage, a movable wall, and an urging member. The first passage extends in the main scanning direction. The guided portion enters the first passage when the binder is in the oblique binding posture. The second passage extends in the main scanning direction on an upstream side from the first passage in the conveyance direction. The guided portion enters the second passage when the binder is in the parallel binding posture. The movable wall moves between a blocking posture in which each of the first passage and the second passage is blocked by the movable wall and the first passage and the second passage communicate with each other and an open posture in which at least one of the first passage or the second passage is open. The urging member urges the movable wall toward the blocking posture. The movable wall guides the guided portion to the second passage while maintaining the blocking posture, when the guided portion moving along the first passage from an end side to a center side in the main scanning direction comes into contact with the movable wall; moves to the open posture and cause the guided portion to pass when the guided portion moving along the second passage from the end side to the center side in the main scanning direction comes into contact with the movable wall; guides the guided portion to the first passage while maintaining the blocking posture, when the guided portion moving along the second passage from the center side to the end side in the main scanning direction comes into contact with the movable wall; and moves to the open posture and cause the guided portion to pass when the guided portion moving along the first passage from the center side to the end side in the main scanning direction comes into contact with the movable wall.

According to another embodiment of the present disclosure, an image forming system includes an image forming apparatus and the medium processing apparatus. The image forming apparatus forms images on a plurality of media. The medium processing apparatus crimps and binds the plurality of media on which the images are formed by the image forming apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of embodiments of the present disclosure and many of the attendant advantages and features thereof can be readily obtained and understood from the following detailed description with reference to the accompanying drawings, wherein:

FIG. **1** is a diagram illustrating the overall configuration of an image forming system according to an embodiment of the present disclosure;

FIG. **2** is a diagram illustrating the internal configuration of a post-processing apparatus in the image forming system of FIG. **1**;

FIG. **3** is a side view of an end binding mechanism according to a first embodiment;

FIG. **4** is a plan view of the end binding mechanism according to the first embodiment;

FIG. **5**A is a diagram of a staple binder viewed from an upper surface side of the staple binder;

FIG. **5**B is a diagram of the staple binder viewed from a lower surface side of the staple binder;

FIG. **6**A is a perspective view of a cam;

FIG. **6**B is a plan view of the cam;

FIG. **7**A is a perspective view of a boss and a restriction wall;

FIG. **7**B is a plan view of the boss and the restriction wall;

FIG. **8**A is a cross-sectional view of a base plate;

FIG. **8**B is a bottom view of the base plate;

FIG. **9** is a perspective view of a movable member;

FIG. **10**A is a perspective view illustrating the movable member attached to the boss;

FIG. **10**B is a plan view illustrating the movable member attached to the boss;

FIG. **11** is a block diagram illustrating a hardware configuration of the post-processing apparatus of FIG. **2** to control the operation of the post-processing apparatus;

FIGS. **12**A, **12**B, **12**C, and **12**D are diagrams illustrating the movement of a cam when a binding section in an oblique binding posture on an end side is brought into a parallel binding posture on the center side;

FIGS. **13**A, **13**B, **13**C, and **13**D are diagrams illustrating the movement of the cam when the binding section in the parallel binding posture on the center side is brought into the oblique binding posture on the end side;

FIGS. **14**A, **14**B, and **14**C are diagrams illustrating the movement of the cam when the binding section in the oblique binding posture on the end side is brought into the parallel binding posture on the end side;

FIGS. **15**A, **15**B, and **15**C are diagrams illustrating the movement of the cam when the binding section in the parallel binding posture at the end side is brought into the parallel binding posture at the center side;

FIGS. **16**A, **16**B, and **16**C are diagrams illustrating positions and orientations of binding staples for binding a sheet bundle;

FIGS. **17**A, **17**C, and **17**C are diagrams illustrating the function of a guide wall;

FIGS. **18**A and **18**B are plan views of an end binding mechanism according to a second embodiment of the present disclosure;

FIGS. **19**A, **19**B, **19**C, and **19**D are diagrams illustrating the motion of a movable wall according to a third embodiment of the present disclosure; and

FIGS. **20**A, **20**B, **20**C, and **20**D are diagrams illustrating the motion of a movable wall according to a fourth embodiment of the present disclosure.

The accompanying drawings are intended to depict embodiments of the present disclosure and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted. Also, identical or similar reference numerals designate identical or similar components throughout the several views.

DETAILED DESCRIPTION

Hereinafter, an embodiment of the present disclosure applied to a color laser printer (hereinafter, simply referred to as a printer) that is an image forming apparatus will be described.

In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this specification is not intended to be limited to the specific terminology so selected and it is to be understood that each specific element includes all technical equivalents that have a similar function, operate in a similar manner, and achieve a similar result.

Referring now to the drawings, embodiments of the present disclosure are described below. As used herein, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise.

Initially, a description is given of a first embodiment of the present disclosure.

With reference to the drawings, a description is now given of an image forming system **1** according to an embodiment of the present disclosure. FIG. **1** is a diagram illustrating the overall configuration of the image forming system **1**. The image forming system **1** has a function of forming an image on a sheet P as a medium and performing post-processing on the sheet P on which the image is formed. As illustrated in FIG. **1**, the image forming system **1** includes an image forming apparatus **2** and a post-processing apparatus **3** (medium processing apparatus).

The image forming apparatus **2** forms an image on the sheet P and ejects the sheet having the image to the post-processing apparatus **3**. The image forming apparatus **2** mainly includes a tray that holds a sheet (sheets) P, a conveyor that conveys the sheet P held in the tray, and an image formed that forms an image on the sheet P conveyed by the conveyor. The image former may be an inkjet image forming device that forms an image with ink or an electrophotographic image forming device that forms an image with toner. Since the image forming apparatus **2** has a typical configuration, a detailed description of the configuration and functions of the image forming apparatus **2** are omitted.

FIG. **2** is a diagram illustrating an internal configuration of the post-processing apparatus **3**. The post-processing apparatus **3** performs post-processing on the sheet P on which an image is formed by the image forming apparatus **2**. The post-processing according to the first embodiment is staple processing for binding a bundle of a plurality of sheets P on which images are formed (hereinafter referred to as a "sheet bundle"). More specifically, the stapling processing according to the first embodiment is so-called "staple binding" in which a staple is passed through a sheet bundle to bind the sheets. Examples of the staple binding include an end binding processing of binding an end of a sheet bundle in the conveyance direction and a saddle binding processing of binding the center of the sheet bundle.

The post-processing apparatus **3** includes the conveyance roller pairs **10** to **19** serving as a conveyor and the switching claw **20**. The conveyance roller pairs **10** to **19** convey, inside the post-processing apparatus **3**, the sheet P supplied from the image forming apparatus **2**. Specifically, the conveyance roller pairs **10** to **13** convey the sheet P along a first conveyance passage Ph**1**. The conveyance roller pairs **14** and **15** convey the sheet P along a second conveyance passage Ph**2**. The conveyance roller pairs **16** to **19** convey the sheet P along a third conveyance passage Ph**3**.

The first conveyance passage Ph**1** is a passage extending to an output tray **21** from a supply port through which the sheet P is supplied from the image forming apparatus **2**. The second conveyance passage Ph**2** is a passage branching from the first conveyance passage Ph**1** between the conveyance roller pairs **11** and **14** in a conveyance direction and extending to an output tray **26** via an internal tray **22**. The third conveyance passage Ph**3** is a passage branching from the first conveyance passage Ph**1** between the conveyance roller pairs **11** and **14** in the conveyance direction and extending to an output tray **30**.

The switching claw **20** is disposed at a branching position of the first conveyance passage Ph**1** and the second conveyance passage Ph**2**. The switching claw **20** can be switched between a first position and a second position. The switching claw **20** in the first position guides the sheet P to be output to the output tray **21** through the first conveyance passage Ph**1**. The switching claw **20** in the second position guides the sheet P conveyed through the first conveyance passage Ph**1** to the second conveyance passage Ph**2**. When a trailing end of the sheet P entering the second conveyance passage Ph**2** passes through the conveyance roller pair **11**, the conveyance roller pair **14** is rotated in the reverse direction to guide the sheet P to the third conveyance passage Ph**3**. The post-processing apparatus **3** further includes a plurality of sensors that detects the positions of the sheet P in the first conveyance passage Ph**1**, the second conveyance passage

Ph2, and the third conveyance passage Ph3. In FIG. 2, each black triangle indicates a sensor that detects the position of the sheet P during conveyance.

The post-processing apparatus 3 includes the output tray 21. The output tray 21 supports the sheet P discharged through the first conveyance path Ph1. Among the sheets P supplied from the image forming apparatus 2, sheets P on which the stapling process is not executed are ejected to the output tray 21.

The post-processing apparatus 3 includes an internal tray 22 (tray), an end fence 23, side fences 24L and 24R, an end binding mechanism 25, and an output tray 26. The internal tray 22, the end fence 23, the side fences 24L and 24R, and the end binding mechanism 25 perform end binding processing on the sheets P conveyed on the second conveyance path Ph2. Among the sheets P supplied from the image forming apparatus 2, a sheet bundle on which the end stitching processing is executed is ejected to the output tray 26. Hereinafter, a direction from the conveyance roller pair 15 toward the end fence 23 is defined as a "sheet conveyance direction" of the sheet P. In addition, a direction orthogonal to both the thickness direction of the sheet P supported by the internal tray 22 and the conveyance direction of the sheet P is defined as a "main scanning direction (width direction of the sheet P)". The conveyance direction, the thickness direction, and the main scanning direction are orthogonal to each other.

The internal tray 22 temporarily supports a plurality of sheets P sequentially conveyed on the second conveyance path Ph2. The end fence 23 aligns the position of the sheet bundle held in the internal tray 22 in the conveyance direction of the sheet bundle. The side fences 24L and 24R align the position of the sheet bundle held in the internal tray 22 in the main scanning direction. The end binding mechanism 25 binds an end portion of the sheet bundle aligned by the end fence 23 and the side fences 24L and 24R. The conveyance roller pair 15 ejects the sheet bundle subjected to the end stitching processing to the output tray 26. The configuration of the end binding mechanism 25 will be described below with reference to FIGS. 3 to 10.

The post-processing apparatus 3 further includes an end fence 27, a binder 28, a sheet folding blade 29, and an output tray 30. The end fence 27, the binder 28, and the sheet folding blade 29 perform saddle stitching processing on the sheet P conveyed on the third conveyance path Ph3. Among the sheets P supplied from the image forming apparatus 2, a sheet bundle subjected to the saddle stitching process is ejected to the output tray 30.

The end fence 27 aligns the positions of the sheets P that are sequentially conveyed through the third conveyance passage Ph3, in a direction in which the sheets P are conveyed. Further, the end fence 27 is movable between a binding position where the center of the sheet bundle faces the binder 28 and a folding position where the center of the sheet bundle faces the sheet folding blade 29. The binder 28 binds the center of the sheet bundle aligned by the end fence 27 at the binding position. The sheet folding blade 29 folds the sheet bundle in half while the sheet bundle is supported by the end fence 27 at the folding position, and then brings the sheet bundle to the conveyance roller pair 18 so that the conveyance roller pair 18 nips the sheet bundle. Then, the conveyance roller pairs 18 and 19 eject the sheet bundle subjected to the saddle stitching process to the output tray 30.

FIG. 3 is a side view of the end binding mechanism 25 according to the first embodiment. FIG. 4 is a plan view of the end binding mechanism 25 according to the first embodiment. As illustrated in FIGS. 3 and 4, the end binding mechanism 25 mainly includes a staple binder 40 which is an example of a binder, a mover 60, and a switcher 70. The staple binder 40 performs staple binding on the plurality of sheets P supported on the internal tray 22. The mover 60 moves the staple binder 40 in the main scanning direction along the surface of the sheet P supported by the internal tray 22. The switcher 70 switches the staple binder 40 (more specifically, a binding section 42 described later) between the oblique binding posture and the parallel binding posture.

FIG. 5A is a diagram of the staple binder 40 viewed from an upper surface side of the staple binder 40. FIG. 5B is a diagram of the staple binder 40 viewed from a lower surface side of the staple binder 40. FIG. 6A is a perspective view of the cam 43. FIG. 6B is a plan view of the cam 43. As illustrated in FIGS. 3 to 6B, the staple binder 40 mainly includes a base 41, the binding section 42, the cam 43, and a transmission mechanism 44.

The base 41 is a plate member that supports the binding section 42, the cam 43, and the transmission mechanism 44. The binding section 42 as a rotary binder is supported on the upper surface side of the base 41 such that the binding section 42 is rotatable about a rotation shaft 45 (first rotation axis) extending in the thickness direction of the sheets P. An external gear 46 is attached to the binding section 42 and rotates together with the binding section 42. The binding section 42 includes, for example, a magazine that stores a plurality of staples and a clamping mechanism that presses staples stored in the magazine against the sheet bundle and clamps the sheet bundle from both sides. The configuration of the binding section 42 may be an already-known configuration.

The cam 43 is supported on the lower surface side of the base 41 such that the cam 43 is rotatable about a rotation shaft 52 (second rotation axis) extending in the thickness direction of the sheet P. As illustrated in FIG. 6A, the cam 43 mainly includes a cylindrical portion 47, a protruding portion 48, and a guided portion 49. The cylindrical portion 47 is a bottomed cylindrical body in which one side in the axial direction is closed and the other side in the axial direction is open. An internal gear 50 is formed on the inner peripheral surface of the cylindrical portion 47. The protruding portion 48 protrudes radially outward from a part of the outer circumferential surface of the cylindrical portion 47. The guided portion 49 protrudes from the distal end of the protruding portion 48 in a direction opposite to the base 41. The guided portion 49 is guided by the switcher 70 to rotate the cam 43.

The transmission mechanism 44 transmits the rotation of the cam 43 to the binding section 42. The transmission mechanism 44 mainly includes rotation shafts 51 and 52, a first gear 53, a second gear 54, and a third gear 55. The components 51, 52, 53, 54, and 55 of the transmission mechanism 44 are disposed inside the cylindrical portion 47 (that is, the internal gear 50).

The rotation shafts 51 and 52 extend in the thickness direction of the sheet P. The rotation shaft 51 is rotatably supported by the cam 43 (more specifically, the cylindrical portion 47) on the lower surface side of the base 41. The rotation shaft 52 is rotatably supported by the base 41 and penetrates the base 41 in the thickness direction. The rotation shaft 52 rotatably supports the cam 43. However, the cam 43 and the rotation shaft 52 rotate independently of each other. In other words, the cam 43 and the rotation shaft 52 do not rotate together.

The first gear 53 is supported by the rotation shaft 51 on the lower surface side of the base 41 and rotates together

with the rotation shaft **51**. The first gear **53** is meshed with the internal gear **50** and the second gear **54**. The second gear **54** is supported by the rotation shaft **52** on the lower surface side of the base **41** and rotates together with the rotation shaft **52**. The second gear **54** is meshed with the first gear **53**. The third gear **55** is supported by the rotation shaft **52** on the upper surface side of the base **41** and rotates together with the rotation shaft **52**. In other words, the rotation shaft **52**, the second gear **54**, and the third gear **55** rotate together. The third gear **55** is meshed with the external gear **46**.

In other words, the rotation of the cam **43** is transmitted to the binding section **42** via the internal gear **50**, the first gear **53**, the second gear **54**, the rotation shaft **52**, the third gear **55**, and the external gear **46**. Accordingly, when the staple binder **40** is viewed in a plan view, the binding section **42** rotates in a direction opposite to the rotation direction of the cam **43**. As a result, the binding section **42** is switched between the oblique binding posture and the parallel binding posture.

As illustrated in FIG. **16**A, the oblique binding posture is a posture of the staple binder **40** (the binding section **42**) that binds a sheet bundle in a state in which the longitudinal direction of each of binding staples S**1** and S**2** is inclined with respect to the main scanning direction. As illustrated in FIGS. **16**B and **16**C, the parallel binding posture is a posture of the staple binder **40** (the binding section **42**) that binds a sheet bundle in a state in which the longitudinal direction of each of the binding staples S**1** and S**2** is oriented in the main scanning direction. The region where the binding staples S**1** and S**2** are arranged on the sheet bundle is an example of a binding region.

The mover **60** mainly includes a guide shaft **61** and a moving motor **62** (see FIG. **11**). The guide shaft **61** extends in the main scanning direction on the downstream side of the internal tray **22** in the conveyance direction. The guide shaft **61** supports the staple binder **40** such that the staple binder **40** is movable in the main scanning direction. The moving motor **62** generates a driving force for moving the staple binder **40** in the main scanning direction. When the driving force of the moving motor **62** is transmitted via the pulleys **63** and **64**, the timing belt **65**, and the like, the staple binder **40** moves in the main scanning direction along the guide shaft **61**.

FIG. **7**A is a perspective view of a boss **73**L (or a boss **73**R) and a restriction wall **74**L (or the restriction wall **74**R). FIG. **7**B is a plan view of the boss **73**L (or the boss **73**R) and the restriction wall **74**L (or the restriction wall **74**R). FIG. **8**A is a cross-sectional view of a base plate **71**. FIG. **8**B is a bottom view of the base plate **71**. FIG. **9** is a perspective view of a movable member **75**L (or a movable member **75**R). FIG. **10**A is a perspective view of the movable member **75**L (or the movable member **75**R) attached to the boss **73**L (or the boss **73**R). FIG. **10**B is a plan view of the movable member **75**L (or the movable member **75**R) attached to the boss **73**L (or the boss **73**R).

The switcher **70** guides the guided portion **49** and rotates the cam **43** to switch the staple binder **40** (more specifically, the staple binding section **42**) between the oblique binding posture and the parallel binding posture. The switcher **70** mainly includes a base plate **71**, guide walls **72***a*, **72***b*, **72***c*, **72***d*, and **72***e*, the bosses **73**L and **73**R, the restriction walls **74**L and **74**R, the movable members **75**L and **75**R, and coil springs **76**L and **76**R (urging members).

As illustrated in FIG. **4**, the base plate **71** is a plate member extending over the entire range of movement of the staple binder **40** below the staple binder **40**. The base plate **71** has a recess **77**. The guide walls **72***a*, **72***b*, **72***c*, **72***d*, and **72***e* are disposed inside the recess **77** at predetermined intervals in the main scanning direction. The guide walls **72***a*, **72***b*, **72***c*, **72***d*, and **72***e* partition the recess **77** into a first passage **77***a* and a second passage **77***b*. The first passage **77***a* and the second passage **77***b* communicate with each other through the gaps between adjacent ones of the guide walls **72***a*, **72***b*, **72***c*, **72***d*, and **72***e*.

The first passage **77***a* extends in the main scanning direction on the downstream side of the second passage **77***b* in the conveyance direction. The guided portion **49** enters the first passage **77***a* when the binding section **42** is in the oblique binding posture. The second passage **77***b* extends in the main scanning direction on the upstream side of the first passage **77***a* in the conveyance direction. The guided portion **49** enters the second passage **77***b* when the binding section **42** is in the parallel binding posture. In other words, when the staple binder **40** moves in the main scanning direction, the guided portion **49** moves along the first passage **77***a* or the second passage **77***b*.

The bosses **73**L and **73**R are spaced apart from each other in the main scanning direction in the recess **77**. More specifically, the boss **73**L is disposed between the guide walls **72***a* and **72***b*, and the boss **73**R is disposed between the guide walls **72***d* and **72***e*. The bosses **73**L and **73**R are disposed at a boundary between the first passage **77***a* and the second passage **77***b* in the conveyance direction. As illustrated in FIG. **7**A, each of the bosses **73**L and **73**R has a cylindrical outer shape protruding from the recess **77** in the thickness direction of the sheet P. As illustrated in FIG. **8**, the internal space of each of the bosses **73**L and **73**R penetrates to the back surface side of the base plate **71**. The bosses **73**L and **73**R rotatably support shaft portions **78**L and **78**R of movable members **75**L and **75**R, respectively, which will be described below.

As illustrated in FIG. **7**, the restriction walls **74**L and **74**R extend from the bosses **73**L and **73**R to both sides in the conveyance direction. The restriction walls **74**L and **74**R, respectively, are disposed at positions at which the restriction walls **74**L and **74**R can come into contact with contact walls **80**L and **80**R of the movable members **75**L and **75**R, which will be described below. The restriction walls **74**L and **74**R, respectively, restrict rotation of the movable members **75**L and **75**R in the first direction, and allow rotation of the movable members **75**L and **75**R in the second direction. On the other hand, the restriction walls **74**L and **74**R are disposed at positions where the restriction walls **74**L and **74**R do not contact the guided portion **49**.

The movable members **75**L and **75**R, respectively, are supported by the bosses **73**L and **73**R such that the movable members **75**L and **75**R are rotatable (an example of movable) about rotation axes extending in the thickness direction of the sheet P. Since the movable members **75**L and **75**R have the same shape except that the left and right (in the main scanning direction) are reversed, the movable member **75**L will be described in detail below. As illustrated in FIG. **9**, the movable member **75**L mainly includes the shaft portion **78**L, a movable wall **79**L, the contact wall **80**L, and an engagement portion **81**L.

As illustrated in FIG. **8**A, the shaft portion **78**L is inserted into the boss **73**L and is rotatably supported. One end of the shaft portion **78**L protrudes toward the upper surface side of the base plate **71**, and the other end of the shaft portion **78**L protrudes toward the lower surface side of the base plate **71**. The movable wall **79**L is attached to one end of the shaft portion **78**L. The movable wall **79**L is disposed at a position where the movable wall **79**L can come into contact with the guided portion **49** and does not come into contact with the

restriction wall **74**L. The longitudinal direction of the movable wall **79**L is oriented in the conveyance direction in a blocking posture (FIG. **12**A) described later, and is oriented in the main scanning direction in an open posture (FIG. **12**C) described later.

The contact wall **80**L protrudes toward the base plate **71** from both sides of the movable wall **79**L in the main scanning direction. When the movable member **75**L is about to rotate in the first direction (counterclockwise in FIG. **10**B), the contact wall **80**L comes into contact with the restriction wall **74**L to prevent the rotation of the movable member **75**L. On the other hand, when the movable member **75**L is about to rotate in the second direction (clockwise in FIG. **10**B), the contact wall **80**L is separated from the restriction wall **74**L to allow the rotation of the movable member **75**L.

As illustrated in FIG. **8**A, the engagement portion **81**L is attached to the other end of the shaft portion **78**L. One end of the coil spring **76**L disposed on the lower surface side of the base plate **71** is locked to the engagement portion **81**L. One end of the coil spring **76**L is engaged with the engagement portion **81**L, and the other end of the coil spring **76**L is fixed to the base plate **71**. The coil spring **76**L spring urges the movable member **75**L such that the movable wall **79**L moves toward the blocking posture. In other words, the movable wall **79**L receives the urging force of the coil spring **76**L and the contact wall **80**L comes into contact with the restriction wall **74**L. Accordingly, the movable wall **79**L is maintained in the blocking posture.

The blocking posture is a posture of the movable wall **79**L taken when each of the first passage **77***a* and the second passage **77***b* is blocked and the first passage **77***a* and the second passage **77***b* are communicated with each other. The longitudinal direction of the movable wall **79**L in the blocking posture is oriented in the conveyance direction. As a result, when the movable wall **79**L is in the blocking posture, the guided portion **49** that moves in the first passage **77***a* or the second passage **77***b* does not go over the movable wall **79**L. On the other hand, when the movable wall **79**L is in the blocking posture, the guided portion **49** can move from one of the first passage **77***a* and the second passage **77***b* to the other of the first passage **77***a* and the second passage **77***b*.

The open posture is a posture of the movable wall **79**L taken when at least one (in the first embodiment, both) of the first passage **77***a* and the second passage **77***b* is opened. The longitudinal direction of the movable wall **79**L in the open posture is oriented in the main scanning direction. In other words, the movable wall **79**L rotates by 90° around the rotation axis (shaft portion **78**L) extending in the thickness direction of the sheet P between the blocking posture and the open posture. As a result, the guided portion **49** moving in the first passage **77***a* or the second passage **77***b* can go over the movable wall **79**L.

When the guided portion **49** moving in the first passage **77***a* from an end side to the center side (the right direction in FIG. **10**B) in the main scanning direction comes into contact with the movable wall **79**L in the blocking posture, the contact wall **80**L comes into contact with the restriction wall **74**L and the movable wall **79**L is maintained in the blocking posture. The guided portion **49** is guided from the first passage **77***a* to the second passage **77***b* along the side surface of the movable wall **79**L maintained in the blocking posture. As a result, the binding section **42** changes its posture from the oblique binding posture to the parallel binding posture.

When the guided portion **49** moving in the second passage **77***b* from an end side to the center side (right direction in FIG. **10**B) in the main scanning direction comes into contact with the movable wall **79**L, the movable wall **79**L rotates from the blocking posture to the open posture. The movable wall **79**L in the open posture causes the guided portion **49** of the second passage **77***b* to pass to the center side in the main scanning direction. When the guided portion **49** passes, the movable wall **79**L returns to the blocking posture by the urging force of the coil spring **76**L.

When the guided portion **49** moving in the second passage **77***b* from the center side to an end side (the left direction in FIG. **10**B) in the main scanning direction comes into contact with the movable wall **79**L in the blocking posture, the contact wall **80**L comes into contact with the restriction wall **74**L, and the movable wall **79**L is maintained in the blocking posture. The guided portion **49** is guided from the second passage **77***b* to the first passage **77***a* along the side surface of the movable wall **79**L maintained in the blocking posture. As a result, the binding section **42** changes its posture from the parallel binding posture to the oblique binding posture.

When the guided portion **49** moving in the first passage **77***a* from the center side to an end side (the left direction in FIG. **10**B) in the main scanning direction comes into contact with the movable wall **79**L, the movable wall **79**L rotates from the blocking posture to the open posture. The movable wall **79**L in the open posture allows the guided portion **49** of the first passage **77***a* to pass to the end side in the main scanning direction. When the guided portion **49** passes, the movable wall **79**L returns to the blocking posture by the urging force of the coil spring **76**L.

FIG. **11** is a block diagram illustrating a hardware configuration of the post-processing apparatus **3** to control an operation of the post-processing apparatus **3**. As illustrated in FIG. **11**, the post-processing apparatus **3** includes a central processing unit (CPU) **101**, a random access memory (RAM) **102**, a read only memory (ROM) **103**, a hard disk drive (HDD) **104**, and an interface (I/F) **105**. The CPU **101**, the RAM **102**, the ROM **103**, the HDD **104**, and the I/F **105** are connected to each other via a common bus **109**.

The CPU **101** is an arithmetic unit and controls the overall operation of the post-processing apparatus **3**. The RAM **102** is a volatile storage medium that allows data to be read and written at high speed. The CPU **101** uses the RAM **102** as a working area for data processing. The ROM **103** is a read-only non-volatile storage medium that stores programs such as firmware. The HDD **104** is a non-volatile storage medium that allows data to be read and written and has a relatively large storage capacity. The HDD **104** stores, e.g., an operating system (OS), various control programs, and application programs.

By an arithmetic function of the CPU **101**, the post-processing apparatus **3** processes, for example, a control program stored in the ROM **103** and an information processing program (application program) loaded into the RAM **102** from a storage medium such as the HDD **104**. Such processing configures a software controller including various functional modules of the post-processing apparatus **3**. The software controller thus configured cooperates with hardware resources of the post-processing apparatus **3** to construct functional blocks that implement functions of the post-processing apparatus **3**. In other words, the CPU **101**, the RAM **102**, the ROM **103**, and the HDD **104** construct a controller **100** that controls the operation of the post-processing apparatus **3**.

The I/F **105** is an interface that connects the conveyance roller pairs **10**, **11**, **14**, and **15**, the switching claw **20**, the side fences **24**L and **24**R, the binding section **42**, the moving motor **62**, and a control panel **110** to the common bus **109**.

The controller **100** operates the conveyance roller pairs **10**, **11**, **14**, and **15**, the switching claw **20**, the side fences **24**L and **24**R, the binding section **42**, and the moving motor **62** through the I/F **105**. The controller **100** also grasps the position of the staple binder **40** in the main scanning direction by a position sensor (e.g., a rotary encoder of the moving motor **62** or a linear encoder disposed on a moving path of the staple binder **40**). Although FIG. **11** illustrates the components that execute the edge stitching processing, the components that execute the saddle stitching process are also similarly controlled by the controller **100**.

The control panel **110** includes an operation device that receives instructions from a user and a display serving as a notifier that notifies the user of information. The operation device includes, for example, hard keys and a touch screen overlaid on a display. The control panel **110** acquires information from the user through the operation device and provides information to the user through the display. Note that a specific example of the notifier is not limited to the display and may be a light emitting diode (LED) lamp or a speaker.

FIGS. **12**A, **12**B, **12**C, and **12**D are diagrams illustrating the movement of the cam **43** when the binding section **42** in the oblique binding posture on the end side is brought into the parallel binding posture on the center side. FIGS. **13**A, **13**B, **13**C, and **13**D are diagrams illustrating the movement of the cam **43** when the binding section **42** in the parallel binding posture on the center side is brought into the oblique binding posture on the end side. FIGS. **14**A, **14**B, and **14**C are diagrams illustrating the movement of the cam **43** when the binding section **42** in the oblique binding posture on the end side is brought into the parallel binding posture on the end side. FIGS. **15**A, **15**B, and **15**C are diagrams illustrating the movement of the cam **43** when the binding section **42** in the parallel binding posture at the end side is brought into the parallel binding posture at the center side. FIGS. **16**A, **16**B, and **16**C are diagrams illustrating positions and orientations of binding staples **51** and S2 (i.e., a binding region) for binding a sheet bundle.

As illustrated in FIG. **12**A, when the guided portion **49** is positioned in the first passage **77***a* on the end side in the main scanning direction with respect to the movable wall **79**L, the binding section **42** is in the oblique binding posture. When the binding section **42** binds the sheet bundle in this state, as illustrated in FIG. **16**A, the lower left corner of the sheet bundle is bound by the binding staple **51** inclined with respect to the main scanning direction.

Next, when the controller **100** drives the moving motor **62** to move the staple binder **40** to the center side in the main scanning direction, as illustrated in FIG. **12**B, the guided portion **49** moving the first passage **77***a* to the center side in the main scanning direction comes into contact with the movable wall **79**L in the blocking posture. The guided portion **49** is guided from the first passage **77***a* to the second passage **77***b* along the side surface of the movable wall **79**L that maintains the blocking posture. As a result, the binding section **42** changes its posture from the oblique binding posture to the parallel binding posture.

When the controller **100** further moves the staple binder **40** to the center side in the main scanning direction, as illustrated in FIG. **12**C, the movable wall **79**L pressed by the guided portion **49** rotates from the blocking posture to the open posture. Then, as illustrated in FIG. **12**D, the guided portion **49** passes through the opened second passage **77***b* and moves to the center side from the movable wall **79**L in the main scanning direction. When the binding section **42** binds a sheet bundle in this state, as illustrated in FIG. **16**B, the central portion of the sheet bundle is bound by the binding staples S1 and S2 parallel to the main scanning direction. Note that the positions and the number of the binding staples S1 and S2 are not limited to the example of FIG. **16**B.

As illustrated in FIG. **13**A, when the guided portion **49** located closer to the center in the main scanning direction than the movable wall **79**L of the second passage **77***b* is moved to the end side in the main scanning direction, the guided portion **49** comes into contact with the movable wall **79**L in the blocking posture as illustrated in FIG. **13**B. Then, the guided portion **49** is guided from the second passage **77***b* to the first passage **77***a* along the side surface of the movable wall **79**L maintaining the blocking posture. As a result, the binding section **42** changes its posture from the parallel binding posture to the oblique binding posture. When the controller **100** further moves the staple binder **40** to the end side in the main scanning direction, as illustrated in FIG. **13**C, the movable wall **79**L pressed by the guided portion **49** rotates from the blocking posture to the open posture. Then, as illustrated in FIG. **13**D, the guided portion **49** moves to the end side in the main scanning direction from the movable wall **79**L through the opened first passage **77***a*.

Further, as illustrated in FIGS. **14**A and **14**B, when the guided portion **49** positioned on the end side in the main scanning direction with respect to the movable wall **79**L of the first passage **77***a* is moved to the center side in the main scanning direction, the guided portion **49** moves to the second passage **77***b*, and the movable wall **79**L changes its posture to the open posture. As a result, the binding section **42** changes its posture from the oblique binding posture to the parallel binding posture. This operation is common to FIGS. **12**A, **12**B, and **12**C. Then, when the controller **100** moves the staple binder **40** to the end side in the main scanning direction before the guided portion **49** passes through the movable wall **79**L, as illustrated in FIG. **14**C, the guided portion **49** moves along the second passage **77***b* to the end side in the main scanning direction. As a result, the staple binder **40** moves to the end side from the movable wall **79**L in the main scanning direction while the binding section **42** remains in the parallel binding posture. When the binding section **42** binds the sheet bundle in this state, as illustrated in FIG. **16**C, the lower left corner of the sheet bundle is bound by the binding staple S1 parallel to the main scanning direction.

Further, as illustrated in FIG. **15**A, when the guided portion **49** positioned on the end side of the movable wall **79**L of the second passage **77***b* in the main scanning direction is moved to the center side in the main scanning direction, the movable wall **79**L pressed by the guided portion **49** rotates from the blocking posture to the open posture as illustrated in FIG. **15**B. Then, as illustrated in FIG. **15**C, the guided portion **49** passes through the opened second passage **77***b* and moves to the center side in the main scanning direction from the movable wall **79**L. As a result, the staple binder **40** reaches the center side in the main scanning direction from the movable wall **79**L while the binding section **42** remains in the parallel binding posture.

Note that the movements of FIGS. **12**A to **15**C can be applied not only between the guided portion **49** and the movable wall **79**L but also between the guided portion **49** and the movable wall **79**R. As an example, when the binding section **42** binds the sheet bundle after the guided portion **49** and the movable wall **79**R move by horizontally reversing FIGS. **13**A to **13**D, the lower right corner of the sheet bundle is bound by the binding staple S2 inclined with respect to the main scanning direction as illustrated in FIG. **16**A. As

another example, when the binding section **42** binds the sheet bundle after the guided portion **49** and the movable wall **79**R move by horizontally reversing FIGS. **14**A to **14**C, the lower right corner of the sheet bundle is bound by the binding staple S**2** parallel to the main scanning direction as illustrated in FIG. **16**C.

FIGS. **17**A, **17**C, and **17**C are diagrams illustrating the function of the guide wall **72***c*. As illustrated in FIGS. **17**A, **17**C, and **17**C, the guide wall **72***c* is disposed closer to the center in the main scanning direction than the movable walls **79**L and **79**R. The length of the guide wall **72***c* in the conveyance direction is longer than the length of each of the other guide walls **72***a*, **72***b*, **72***d*, and **72***e*. The guide wall **72***c* blocks the first passage **77***a* and opens the second passage **77***b*. The first passage **77***a* and the second passage **77***b* communicate with each other at both ends of the guide wall **72***c* in the main scanning direction.

As illustrated in FIG. **17**A, the guide wall **72***c* allows the guided portion **49** to pass through the second passage **77***b*. As illustrated in FIG. **17**B, the guide wall **72***c* prevents the guided portion **49** from passing through the first passage **77***a*. Further, as illustrated in FIG. **17**C, the guided portion **49** moving in the first passage **77***a* comes into contact with the guide wall **72***c*, and thus the guide wall **72***c* guides the guided portion **49** to the second passage **77***b*.

According to the above-described embodiment, for example, the following operational effects can be obtained.

In a case of a typical configuration in which a binder largely rotates, a large space is needed to change the posture of the binder. As a result, a medium processing apparatus increases in size.

According to the embodiment described above, the posture of the staple binder **40** (the binding section **42**) can be switched by allowing the movable walls **79**L and **79**R to rotate toward one side and restricting the movable walls **79**L and **79**R from rotating toward the other side. Thus, the posture of the staple binder **40** can be changed with a small and simple configuration. When the guided portion **49** passes through the movable walls **79**L and **79**R, the movable walls **79**L and **79**R are immediately changed to the blocking posture by the coil springs **76**L and **76**R. Thus, the processing time can be reduced when the posture of the staple binder **40** is continuously changed.

Further, according to the above-described embodiment, the bosses **73**L and **73**R, the restriction walls **74**L and **74**R, the movable members **75**L and **75**R, and the coil springs **76**L and **76**R are disposed at two positions separated from each other in the main scanning direction. Thus, the oblique binding and the parallel binding can be performed on both sides in the main scanning direction.

Further, according to the above-described embodiment, the transmission mechanism **44** is accommodated inside the internal gear **50**. Thus, the size of the mechanism for changing the posture of the binding section **42** can be reduced. In addition, the transmission mechanism **44** is interposed instead of directly transmitting the rotation of the cam **43** to the binding section **42**. Thus, the rotation amount of the cam **43** can be amplified or reduced and transmitted to the binding section **42**.

Further, according to the above-described embodiment, when the binder **40** passes between the movable members **75**L and **75**R, the binding section **42** can be forcibly changed to the parallel binding posture by the guide wall **72***c*. Accordingly, even in a case where the oblique binding posture is maintained due to insufficient rotation of the cam **43** when passing through the movable walls **79**L and **79**R, the binding section **42** can be switched to the parallel binding posture.

Now, a description is given of a second embodiment of the present disclosure.

FIGS. **18**A and **18**B are plan views of an end binding mechanism **25**A according to the second embodiment. Note that the detailed description of the conveyance deviation correcting process common to the first embodiment is omitted and the description of the second embodiment different from the first embodiment is given. The end binding mechanism **25**A according to the second embodiment is different from the end binding mechanism **25** of the first embodiment in that the end binding mechanism **25**A further includes a crimp binder **82** serving as a second binder. The crimp binder **82** executes so-called "crimp binding" of pressing and deforming a sheet bundle in the thickness direction to bind the sheet bundle. The configuration of the crimp binder **82** may be an already-known configuration.

The staple binder **40** and the crimp binder **82** are disposed at positions separated from each other in the main scanning direction. The mover **60** moves the staple binder **40** and the crimp binder **82** independently of each other in the main scanning direction. The standby position of the staple binder **40** is at an end on one side (left side in the example of FIGS. **18**A and **18**B) in the main scanning direction, and the standby position of the crimp binder **82** is at an end on the other side (right side in the example of FIGS. **18**A and **18**B) in the main scanning direction.

As illustrated in FIG. **18**B, the staple binder **40** sets the binding section **42** to the parallel binding posture while waiting at the waiting position (a state in which the sheet bundle is not bound). At this time, the end portion (FIG. **18**B) on the center side in the main scanning direction of the staple binder **40** in the parallel binding posture is positioned closer to the end side in the main scanning direction than in the oblique binding posture (FIG. **18**A). In other words, the staple binder **40** in the parallel binding posture is caused to stand by at the standby position, thus increasing the movement range of the crimp binder **82** in the main scanning direction as compared with the case where the staple binder **40** in the oblique binding posture is caused to stand by at the standby position.

According to the second embodiment, the range in the main scanning direction in which the crimp binding can be performed by the crimp binder **82** can be increased. A specific example of the combination of the first binder and the second binder is not limited to the example of FIGS. **18**A and **18**B. As another example, both the first binder and the second binder may be the staple binder **40**.

Third Embodiment

FIGS. **19**A, **19**B, **19**C, and **19**D are diagrams illustrating the motion of the movable wall **83**L according to the third embodiment. Note that the detailed description of the conveyance deviation correcting process common to the first embodiment is omitted and the description of the second embodiment different from the first embodiment is given. The movable wall **83**L according to the third embodiment is different from the movable wall **79**L that rotates around the rotation axis extending in the thickness direction of the sheet P in that the movable wall **79**L slides in the conveyance direction (another example of the movement of the movable wall **79**L).

As illustrated in FIGS. **19**A, **19**B, **19**C, and **19**D, in the side surface of the movable wall **83**L facing the center side

(right side in FIGS. **19**A, **19**B, **19**C, and **19**D) in the main scanning direction, a portion positioned in the first passage **77***a* in the blocking posture is inclined with respect to the main scanning direction, and the other portion is orthogonal to the main scanning direction. In the side surface of the movable wall **83**L facing the end side in the main scanning direction (left side in FIGS. **19**A, **19**B, **19**C, and **19**D), a portion positioned in the second passage **77***b* in the blocking posture is inclined with respect to the main scanning direction, and the other portion is orthogonal to the main scanning direction. The movable wall **83**R having a shape obtained by horizontally inverting the movable wall **83**L is provided at a position spaced apart from the movable wall **83**L in the main scanning direction.

As illustrated in FIG. **19**A, when the guided portion **49** moving toward the center of the first passage **77***a* in the main scanning direction comes into contact with the movable wall **83**L in the blocking posture, the movable wall **83**L maintains the blocking posture and guides the guided portion **49** to the second passage **77***b*. As illustrated in FIG. **19**B, when the guided portion **49** that moves the second passage **77***b* toward the center in the main scanning direction comes into contact with the movable wall **83**L in the blocking posture, the movable wall **83**L slides toward the downstream side in the conveyance direction and changes its posture to the open posture to open the second passage **77***b*. As a result, the guided portion **49** can move in the second passage **77***b* toward the center in the main scanning direction from the movable wall **83**L.

As illustrated in FIG. **19**C, when the guided portion **49** moving on the second passage **77***b* to the end side in the main scanning direction comes into contact with the movable wall **83**L in the blocking posture, the movable wall **83**L maintains the blocking posture and guides the guided portion **49** to the first passage **77***a*. As illustrated in FIG. **19**D, when the guided portion **49** that moves the first passage **77***a* to the end side in the main scanning direction comes into contact with the movable wall **83**L in the blocking posture, the movable wall **83**L slides to the upstream side in the conveyance direction and changes the posture to the open posture to open the first passage **77***a*. Accordingly, the guided portion **49** can move in the first passage **77***a* to the end side in the main scanning direction with respect to the movable wall **83**L.

Fourth Embodiment

FIGS. **20**A, **20**B, **20**C, and **20**D are diagrams illustrating the motion of a movable wall **84**L according to the fourth embodiment. Note that the detailed description of the conveyance deviation correcting process common to the first embodiment is omitted and the description of the second embodiment different from the first embodiment is given. The movable wall **84**L according to the fourth exemplary embodiment is different from the movable wall **79**L that rotates around the rotation axis extending in the thickness direction of the sheet P in that the movable wall **84**L includes a first roller **85***a* and a second roller **85***b* that rotate around the rotation axes extending in the conveyance direction (another example of the movement of the movable wall). The movable wall **84**R having a shape obtained by horizontally inverting the movable wall **84**L is provided at a position spaced apart from the movable wall **84**L in the main scanning direction.

The first roller **85***a* is disposed in the first passage **77***a*. As illustrated in FIG. **20**A, when the guided portion **49** moving in the first passage **77***a* toward the center in the main scanning direction comes into contact with the first roller **85***a*, the first roller **85***a* maintains the blocking posture and guides the guided portion **49** to the second passage **77***b*. On the other hand, as illustrated in FIG. **20**D, when the guided portion **49** moving on the first passage **77***a* toward the end side in the main scanning direction comes into contact with the first roller **85***a*, the first roller **85***a* rotates around the rotation axis extending in the conveyance direction and changes its posture to the open posture. As a result, the guided portion **49** can move to the end side in the main scanning direction from the movable wall **84**L in the opened first passage **77***a*.

The second roller **85***b* is disposed in the second passage **77***b*. As illustrated in FIG. **20**B, when the guided portion **49** that moves the second passage **77***b* toward the center side in the main scanning direction comes into contact with the second roller **85***b*, the second roller **85***b* rotates around the rotation axis extending in the conveyance direction and changes its posture to the open posture. As a result, the guided portion **49** can move in the opened second passage **77***b* toward the center side in the main scanning direction from the movable wall **84**L. On the other hand, as illustrated in FIG. **20**C, when the guided portion **49** moving on the second passage **77***b* toward the end side in the main scanning direction comes into contact with the second roller **85***b*, the second roller **85***b* maintains the blocking posture and guides the guided portion **49** to the first passage **77***a*.

The control method described above may be implemented by, for example, a program. For example, the control method may be executed by causing an arithmetic device, a storage device, an input device, an output device, and a control device to operate in cooperation with each other based on a program. The program may be written in, for example, a storage device or a storage medium and distributed, or may be distributed through, for example, an electric communication line.

Embodiments of the present disclosure are not limited to the above-described embodiments, and numerous additional modifications and variations are possible in light of the teachings within the technical scope of the appended claims. It is therefore to be understood that the disclosure of this patent specification may be practiced otherwise by those skilled in the art than as specifically described herein, and such, modifications, alternatives are within the technical scope of the appended claims. Such embodiments and variations thereof are included in the scope and gist of the embodiments of the present disclosure and are included in the embodiments described in claims and the equivalent scope thereof.

Now, a description is given of some aspects of the present disclosure.

Initially, a description is given of a first aspect.

A medium processing apparatus includes: a conveyor to convey a medium in a conveyance direction; a tray to support a plurality of media conveyed by the conveyor; a binder to bind the plurality of media supported on the tray; a mover to move the binder in a main scanning direction orthogonal to the conveyance direction along a surface of the plurality of media supported on the tray; and a switcher to guide a guided portion of the binder to switch between an oblique binding posture in which a longitudinal direction of a binding region bound by the binder is inclined with respect to the main scanning direction and a parallel binding posture in which the longitudinal direction of the binding region is oriented in the main scanning direction. The switcher includes: a first passage extending in the main scanning direction, the guided portion to enter the first passage when

the binder is in the oblique binding posture; a second passage extending in the main scanning direction on an upstream side from the first passage in the conveyance direction, the guided portion to enter the second passage when the binder is in the parallel binding posture; a movable wall to move between a blocking posture in which each of the first passage and the second passage is blocked by the movable wall and the first passage and the second passage communicate with each other and an open posture in which at least one of the first passage or the second passage is open; and an urging member to urge the movable wall toward the blocking posture. The movable wall is to: guide the guided portion to the second passage while maintaining the blocking posture, when the guided portion moving along the first passage from an end side to a center side in the main scanning direction comes into contact with the movable wall; move to the open posture and cause the guided portion to pass when the guided portion moving along the second passage from the end side to the center side in the main scanning direction comes into contact with the movable wall; guide the guided portion to the first passage while maintaining the blocking posture, when the guided portion moving along the second passage from the center side to the end side in the main scanning direction comes into contact with the movable wall; and move to the open posture and cause the guided portion to pass through when the guided portion moving along the first passage from the center side to the end side in the main scanning direction comes into contact with the movable wall.

Now, a description is given of a second aspect.

The medium processing apparatus according to the first aspect, wherein the movable wall and the urging member are disposed at two positions away from each other in the main scanning direction.

Now, a description is given of a third aspect.

In the medium processing apparatus according to the first or second aspect, the binder includes: a binding section to rotate around a first rotation axis between the parallel binding posture and the oblique binding posture, the first rotation axis extending in a thickness direction of the medium supported on the tray; a cam including the guided portion and an internal gear, the cam to rotate around a second rotation axis extending in the thickness direction; and a transmission mechanism disposed on an inner side of the internal gear, the transmission mechanism to transmit rotation of the cam to the binding section.

Now, a description is given of a fourth aspect.

In the medium processing apparatus according to the third aspect, the binder includes a base rotatably supporting the binding section on an upper surface of the base and rotatably supporting the cam on a lower surface of the base. The binding section includes an external gear. The transmission mechanism includes: a first gear on a lower surface side of the base, the first gear meshing with the internal gear to rotate; a second gear on a lower surface side of the base, the second gear meshing with the first gear to rotate; a third gear on an upper surface side of the base, the third gear meshing with the external gear to rotate; and a rotation shaft passing through the base in the thickness direction to rotate together with the second gear and the third gear.

Now, a description is given of a fifth aspect.

In the medium processing apparatus according to any one of the first to fourth aspects, the switcher includes a guide wall at a position closer to a center of the first passage in the main scanning direction than the movable wall is. The guide wall is to block the first passage and guide the guided portion placed in the first passage to the second passage.

Now, a description is given of a sixth aspect.

In the medium processing apparatus according to any one of the first to firth aspects, the binder includes a first binder and a second binder at positions away from the binder in the main scanning direction. The first binder and the second binder are to be moved independently of each other by the mover.

When the first binder is moved to an end in the main scanning direction by the mover, one end of the first binder, which is closer to the center side in the main scanning direction, in the parallel binding posture is at a position closer to the end side in the main scanning direction than in the oblique binding posture.

Now, a description is given of a seventh aspect.

In the medium processing apparatus according to the sixth aspect, the mover is to: move the first binder in the oblique binding posture, which is at a position closer to an end in the main scanning direction than the movable wall is, toward the center side in the main scanning direction to change a posture of the first binder to the parallel binding posture; and move the first binder to the end side in the main scanning direction before the guided portion passes the movable wall in the open posture, to change the posture of the first binder to the parallel binding posture at a position closer to the end in the main scanning direction than the movable wall is.

Now, a description is given of an eighth aspect.

In the medium processing apparatus according to the sixth aspect, the first binder is a staple binder to bind, with a staple, the plurality of media supported on the tray, and the second binder is a crimp binder to press and deform the plurality of media supported on the tray to bind the plurality of media.

Now, a description is given of a ninth aspect.

An image forming system includes: an image forming apparatus to form an image on a medium; the medium processing apparatus according to any one of the first to eighth aspects, to crimp and bind the plurality of media on which the images are formed by the image forming apparatus.

The above-described embodiments are illustrative and do not limit the present invention. Thus, numerous additional modifications and variations are possible in light of the above teachings. For example, elements and/or features of different illustrative embodiments may be combined with each other and/or substituted for each other within the scope of the present invention.

Any one of the above-described operations may be performed in various other ways, for example, in an order different from the one described above.

Each of the functions of the described embodiments may be implemented by one or more processing circuits or circuitry. Processing circuitry includes a programmed processor, as a processor includes circuitry. A processing circuit also includes devices such as an application specific integrated circuit (ASIC), digital signal processor (DSP), field programmable gate array (FPGA), and conventional circuit components arranged to perform the recited functions.

The invention claimed is:

1. A medium processing apparatus, comprising:

a conveyor to convey a medium in a conveyance direction;

a tray to support a plurality of media conveyed by the conveyor;

a binder to bind the plurality of media supported on the tray;

a mover to move the binder in a main scanning direction orthogonal to the conveyance direction along a surface of the plurality of media supported on the tray; and

a switcher to guide a guided portion of the binder to switch between an oblique binding posture in which a longitudinal direction of a binding region bound by the binder is inclined with respect to the main scanning direction and a parallel binding posture in which the longitudinal direction of the binding region is oriented in the main scanning direction,

the switcher including:

a first passage extending in the main scanning direction, the guided portion to enter the first passage when the binder is in the oblique binding posture;

a second passage extending in the main scanning direction on an upstream side from the first passage in the conveyance direction, the guided portion to enter the second passage when the binder is in the parallel binding posture;

a movable wall to move between a blocking posture in which each of the first passage and the second passage is blocked by the movable wall and the first passage and the second passage communicate with each other and an open posture in which at least one of the first passage or the second passage is open; and

an urging member to urge the movable wall toward the blocking posture, the movable wall to:

guide the guided portion to the second passage while maintaining the blocking posture, when the guided portion moving along the first passage from an end side to a center side in the main scanning direction comes into contact with the movable wall,

move to the open posture and cause the guided portion to pass when the guided portion moving along the second passage from the end side to the center side in the main scanning direction comes into contact with the movable wall;

guide the guided portion to the first passage while maintaining the blocking posture, when the guided portion moving along the second passage from the center side to the end side in the main scanning direction comes into contact with the movable wall; and

move to the open posture and cause the guided portion to pass when the guided portion moving along the first passage from the center side to the end side in the main scanning direction comes into contact with the movable wall.

2. The medium processing apparatus according to claim **1**, wherein the movable wall and the urging member are disposed at two positions away from each other in the main scanning direction.

3. The medium processing apparatus according to claim **1**, wherein the binder includes:

a binding section to rotate around a first rotation axis between the parallel binding posture and the oblique binding posture, the first rotation axis extending in a thickness direction of the medium supported on the tray;

a cam including the guided portion and an internal gear, the cam to rotate around a second rotation axis extending in the thickness direction; and

a transmission mechanism disposed on an inner side of the internal gear, the transmission mechanism to transmit rotation of the cam to the binding section.

4. The medium processing apparatus according to claim **3**, wherein the binder includes a base rotatably supporting the binding section on an upper surface of the base and rotatably supporting the cam on a lower surface of the base,

wherein the binding section includes an external gear, and

wherein the transmission mechanism includes:

a first gear on a lower surface side of the base, the first gear meshing with the internal gear to rotate;

a second gear on a lower surface side of the base, the second gear meshing with the first gear to rotate;

a third gear on an upper surface side of the base, the third gear meshing with the external gear to rotate; and

a rotation shaft passing through the base in the thickness direction to rotate together with the second gear and the third gear.

5. The medium processing apparatus according to claim **1**, wherein the switcher includes a guide wall at a position closer to a center of the first passage in the main scanning direction than the movable wall is, the guide wall to block the first passage and guide the guided portion placed in the first passage to the second passage.

6. The medium processing apparatus according to claim **1**, further comprising another binder at a position away from the binder in the main scanning direction, said another binder to be moved independently of the binder by the mover,

wherein when the binder is moved to an end in the main scanning direction by the mover, one end of the binder, which is closer to the center side in the main scanning direction, in the parallel binding posture is at a position closer to the end side in the main scanning direction than in the oblique binding posture.

7. The medium processing apparatus according to claim **6**, wherein the mover is to:

move the binder in the oblique binding posture, which is at a position closer to an end in the main scanning direction than the movable wall is, toward the center side in the main scanning direction to change a posture of the binder to the parallel binding posture; and

move the binder to the end side in the main scanning direction before the guided portion passes the movable wall in the open posture, to change the posture of the binder to the parallel binding posture at a position closer to the end in the main scanning direction than the movable wall is.

8. The medium processing apparatus according to claim **6**, wherein the binder is a staple binder that binds the plurality of media supported on the tray with a staple, and

wherein said another binder is a crimp binder to press and deform the plurality of media supported on the tray to bind the plurality of media.

9. An image forming system, comprising:

an image forming apparatus to form images on a plurality of media; and

the medium processing apparatus according to claim **1**, to crimp and bind the plurality of media on which the images are formed by the image forming apparatus.

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